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The MONTHLY REVIEW

Published by the

American Electro-Platers' Society

A SOCIETY FOR THE ADVANCEMENT OF THE SCIENCE OF ELECTRO-PLATING

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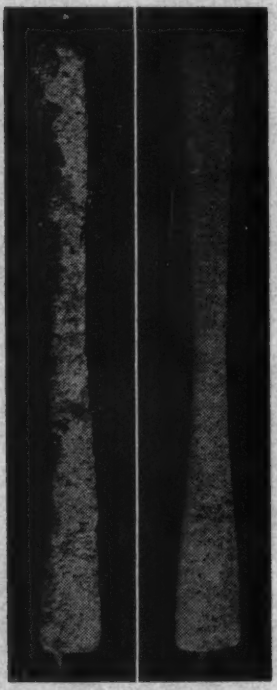
ZINC PLATING

THE TOPIC OF THE HOUR

ZAM ANODES

(ZINC - ALUMINUM - MERCURY)



From unretouched photographs:
At left: Ordinary high purity zinc anode showing corrosion in zinc plating solution.
At right: ZAM Anode in same solution.

eliminate sludge

Where ordinary high purity zinc anodes are used in either acid or cyanide solutions, they are chemically attacked even when not plating. This results in loss of actual metal due to sludge formation. It does not give uniform operating conditions as the voltage has to be increased to overcome the polarization caused by the sludge on the anodes. This results in a non-uniform distribution of current and an uneven coating of zinc. It finally necessitates stopping operations, removing the anodes for cleaning and filtering the solution. The delays are expensive. The labor cost, the stoppage of production and the loss of metal in the sludge increase operating costs.

ZAM Anodes are not chemically attacked. They go into solution only when the current is applied. They only work when you need them. There is no sludge formation, no loss of metal and no polarization. They give uniform operating conditions. They permit the use of higher current densities than ever before used in commercial zinc plating practice. Cleaning of anodes and filtering of solutions are eliminated. They can be used to completion and eliminate scrap. The deposited metal is pure zinc and can be built up to any thickness required. This deposit is ductile. It will withstand any forming operations.

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The MONTHLY REVIEW

Published by the
AMERICAN ELECTRO-PLATERS' SOCIETY

Publication and Editorial Office
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VOL. XXII MAY 1935 NO. 5

The Future *of* Electro-Plating

By WALTER R. MEYER
General Electric Co., Bridgeport
Member Bridgeport Branch

THE question constantly confronts us as members of the American Electro-platers' Society "what is the future of the electro-plating industry?" Will the future plater just be a "foreman" leaving the technical end under control of a chemist or metallurgist and will the "stainless" alloys, metal spraying and oxidation-coloring processes replace electro-deposition? Both possibilities have already occurred in part and the extinction of the plater is inevitable unless we awake to meet the challenge confronting us. Cost accounting is being closely applied to electro-deposition. Control of solutions and operating conditions are indispensable for maximum efficiency and to meet rigid specifications.

Your former president Mr. VanDerau presented a stirring charge to the Society at the Chicago Convention of 1933. Re-read it and take the words to heart. Make use of the chemist, follow the technical developments of the industry and learn the technical fundamentals of your profession. The REVIEW is doing its part by the fine articles, its abstract section, and the lessons in chemistry.

We must forge ahead in new developments. Germany has produced barrel chrome plating, bright nickel, brilliant black chrome plating, very adherent coatings on aluminum, photographs on anodized aluminum, chrome baths that need no exhausts because of the absence of fumes, and protective anodic coatings for magnesium alloys. What new have we to offer?

Our answer will be given at the annual Convention of the

Society in June. You owe it to yourself, your company, and the society to attend.

Electro deposition is no longer an art; it is both an art and a science. It is beyond our scope that we be an expert chemist, metallurgist, electrical engineer, foreman, and artist all in one but at the same time we cannot escape from the reality that certain major principles must be culled from them all. The doom of the "formula" plater has been sounded but not for the plater who has kept abreast of the developments of his profession. There is, and will be, room for the "stainless" steels, metal spraying, synthetic enamels, anodizing as well as electro-plating but we are on the defensive with weapons of new processes and rigid control of present methods.

Our future is bright but will only remain so as long as we are progressive.

WALTER R. MEYER

Tentative Specifications for Electro-deposited Coatings of Zinc on Steel

Scope

1. These specifications cover requirements for electroplated zinc coatings on steel articles that are required to withstand corrosion.

Two types of coating are covered; namely,
Type LS — For general service (See Note 1)
Type RS — For mild service

Manufacture

2. The steel to be plated shall be substantially free from flaws or defects that are detrimental to the appearance or the protective value of the coatings. It shall be subjected to such cleaning, pickling and plating procedures as are necessary to yield deposits with the desired quality. The zinc coating shall have a uniform appearance, be adherent and free from blisters and be substantially free from other defects that may affect the appearance or protective value of the coatings..

Minimum Thickness of Deposits

3. *Type LS.* On significant surfaces, the minimum thickness of the zinc coating shall be not less than 0.0005 in.

Type RS. On significant surfaces, the minimum thickness of the zinc coating shall be not less than 0.00015 in.

Thickness Measurements

4. The minimum thickness of the zinc coatings shall be determined by microscopic examination, or other methods as agreed upon.

Significant Surfaces

5. In general, significant surfaces are those surfaces that are visible and subjected to wear and/or corrosion. The designation of significant surfaces as agreed upon by the parties concerned, and may be indicated on the drawings.

Sampling

6. Methods of sampling and resampling and the basis of rejection shall be subject to mutual agreement by parties concerned. The number of samples to be selected and the frequency of selection will, in general, depend upon the quantity involved.

Notes

Note 1. *Explanation of Symbols.* The initial letters L and R were adopted as arbitrary designations of grades of plating. The second letter (S) refers to steel as the base metal; to provide for other base metals such as brass (B) and zinc (Z).

Note 2. *Classification.* The conditions of exposure and use of plated steel are so varied that it is not possible to predict the average life of articles plated in accordance with Type LS or Type RS, or to predetermine just which type of plating should be specified for a given article. Such a selection must be based upon the experience of the manufacturers and users.

It is recognized that uses exist for which thicker coatings than those of LS will be required.

For articles that are intended for a short period of use, no standard specification for plating is recommended. It is suggested, however, that subject to the prevailing manufacturing conditions, certain minimum requirements be mutually agreed upon in order to insure that the plated coatings render a useful service.

Appendix A

Time Required for Plating. Any specified thickness of plating can be produced consistently only if the current density and time of plating are controlled. Regulation of the voltage is of no value except so far as it produces the desired current density.

The average thickness of deposit that is required to produce a specified minimum thickness of deposit will depend upon the shape of the article, the shape and position of the anodes, and the throwing power of the solution. Purely for illustration, it will be assumed that the average thickness will be 50 per cent greater than the minimum thickness. The resultant figures serve only as a rough guide and must be confirmed by trial for the articles concerned.

To deposit 0.001 in. of zinc with high efficiency in either acid or cyanide baths, it requires about 14 ampere hours per square foot. To produce an average thickness of 0.00075 in. (that is, 50 per cent more than the minimum thickness of 0.0005 in. specified for Type LS), it will therefore require about 11 ampere hours per square foot. This is equivalent to one hour's plating at 11 amperes per square foot, or to a corresponding period for any other current density. Similarly for Type RS, it will require about 3.5 ampere hours per square foot to deposit an average of 0.00023 in. of zinc (or a minimum of 0.00015 in.).

For complicated shapes, longer periods will be required, When a large number of small articles are plated simultaneously, (for example on a rack or in a barrel), the time of plating must be increased to insure the specified thickness on those articles that receive less than the average current density.

Editors Note — Due to the volume of material regarding our forthcoming convention it has been necessary to omit from this issue of the MONTHLY REVIEW a most instructive article, "The Detergent Properties of Alkalies" by Mr. N. Promisel of the International Silver Co., and other items. These will appear in the June issue.

Tentative Specifications for Electrodeposited Coatings of Cadmium on Steel

Scope

1. These specifications cover requirements for electroplated cadmium coatings on steel articles that are required to withstand corrosion.

Two types of service are covered; namely

Type NS — For general service (See Note 1)

Type TS — For mild service

Manufacture

2. The steel to be plated shall be substantially free from flaws or defects that will be detrimental to the appearance or the protective value of the coatings. It shall be subjected to such cleaning, pickling and plating procedures as are necessary to yield deposits with the desired quality. The cadmium coating shall have a uniform appearance bright or dull as specified, be adherent and free from blisters and be substantially free from other defects that may affect the appearance or protective value of the coatings.

Minimum Thickness of Deposits

3. *Type NS.* On significant surfaces, the minimum thickness of the cadmium coating shall be not less than 0.0005 in.

Type TS. On significant surfaces, the minimum thickness of the cadmium coatings shall be not less than 0.00015 in.

Thickness Measurements

4. The minimum thickness of the cadmium coatings shall be determined by microscopic examination, or other methods as agreed upon.

Significant Surfaces

5. In general, significant surfaces are those surfaces that are visible and subjected to wear and/or corrosion. The designation of significant surfaces as agreed upon by the parties concerned, and may be indicated on the drawings.

Sampling

6. Methods of sampling and resampling and the basis of rejection shall be subject to mutual agreement by parties concerned. The number of samples to be selected, and the frequency of selection will, in general, depend upon the quantity involved.

Notes

Note 1. *Explanation of Symbols.* The initial letters N and T were adopted as arbitrary designations of grades of plating. The second letter (S) refers to steel as the base metal; to provide for other base metals such as brass (B) and zinc (Z).

Note 2. *Classification.* The conditions of exposure and use of plated steel are so varied that it is not possible to predict the average life of articles plated in accordance with Type NS or Type TS, or to predetermine just which type of plating should be specified for a given article. Such a selection must be based upon the experience of the manufacturers and users.

It is recognized that uses exist for which thicker coatings than those of NS will be required.

For articles that are intended for a short period of use, no standard specification for plating is recommended. It is suggested, however, that subject to the prevailing manufacturing conditions, certain minimum requirements be mutually agreed upon in order to insure that the plated coatings render a useful service.

Appendix A

Time Required for Plating. Any specified thickness of plating can be produced consistently only if the current density and time of plating are controlled. Regulation of the voltage is of no value except so far as it produces the desired current density.

The average thickness of deposit that is required to produce a specified minimum thickness of deposit will depend upon the shape of the article, the shape and position of the anodes, and the throwing power of the solution. Purely for illustration it will be assumed that the average thickness will be 50 per cent greater than the minimum thickness. The resultant figures serve only as a rough guide and must be confirmed by trial for the articles concerned.

To deposit 0.001 in. of cadmium with high efficiency, it requires about 10 ampere hours per square foot. To produce an

average thickness of 0.00075 in. (that is, 50 per cent more than the minimum thickness of 0.0005 in. specified for Type NS), it will therefore require about 7.5 ampere hours (450 ampere minutes) per square foot. This is equivalent to one hour's plating at 7.5 amperes per square foot or to a corresponding period for any other current density. Similarly for Type TS, it will require about 2.5 ampere hours per square foot to deposit an average of 0.00023 in. of cadmium (or a minimum of 0.00015 in.).

For complicated shapes, longer periods will be required. When a large number of small articles are plated simultaneously (for example on a rack or in a barrel), the time of plating must be increased to insure the specified thickness on those articles that receive less than the average current density.

Tentative Specifications for Electrodeposited Coatings of Nickel and Chromium on Steel

Scope

1. These specifications cover requirements for electroplated coatings on steel articles including a final coating of nickel or chromium where both appearance and protection against corrosion of the base metal are important.

Two types of coating are covered; namely,

Type KS — For general service (See Note 1)

Type QS — For mild service.

Manufacture

2. The steel to be plated shall be substantially free from flaws or defects that are detrimental to the final finish. It shall be subjected to such polishing, cleaning, pickling and plating procedures as are necessary to yield deposits with the desired appearance and quality. The use of copper as an initial or intermediate layer is optional, and subject to the requirements in Section 3. The coatings shall have a bright or dull finish as specified, and shall be adherent and free from blisters, and substantially free from pits or other surface defects.

Thickness of Finished Deposits

3. Type KS.

(a) *Nickel and Copper.* On significant surfaces of the finished articles the minimum thickness of nickel, or of the combined layers of copper and nickel, shall be not less than 0.00075 in., and if copper is used, the minimum thickness of the final nickel layer shall be not less than 0.0004 in.

(b) *Chromium.* If a chromium finish is specified, the minimum thickness of the copper and nickel on significant surfaces shall be as above, and the average* thickness of the chromium shall be not less than 0.00002 in.

4. Type QS.

(a) *Nickel and Copper.* On significant surfaces the minimum thickness of nickel, of or the combined copper and nickel layers, shall be not less than 0.0004 in., and if copper is used, the minimum thickness of the final nickel layer shall be not less than 0.0002 in.

(b) *Chromium.* If a chromium finish is specified, the minimum thickness of the copper and nickel shall be as above and the average thickness of the chromium shall be not less than 0.00002 in.

Thickness Measurements. The minimum thicknesses of the copper and nickel shall be determined by microscopic examination of cross sections taken perpendicular to significant surfaces.

The average thickness of chromium shall be determined by microscopic examination, by stripping methods, or by other methods to be agreed upon.

Methods of Tests for Continuity

5. For Type KS the plated articles shall show no appreciable corrosion on significant surfaces at the end of 48 hr. continuous exposure to the salt spray test; and for Type QS at the end of 16 hr. continuous exposure to the salt spray test (See Note 3).

Unless otherwise agreed upon, "appreciable corrosion" shall be defined as the presence of more than 6 rust spots per square foot that are visible to the unaided eye, or of any rust spots larger than 1/16 in. in diameter.

Significant Surfaces

6. In general, significant surfaces are those surfaces that are

visible and subjected to wear and/or corrosion. The designation of significant surfaces as agreed upon by the parties concerned, and may be indicated on the drawings.

Sampling

7. Methods of sampling and resampling and the basis of rejection shall be subject to mutual agreement by parties concerned. The number of samples to be selected and the frequency of selection will, in general, depend upon the quantity involved.

Summary

8.	Type KS	Type QS
Minimum Thickness (in.)		
Copper +Nickel	0.00075	0.0004
Final Nickel	0.0004	0.0002
Average Thickness (in.)		
Chromium (if required)	0.00002	0.00002
Salt Spray (hr.)	48	16

Notes

Note 1. *Explanation of symbols.* The initial letters K, Q, etc., were adopted as arbitrary designations of grades of plating. The second Letter (S) refers to steel as the base metal; to provide for other base metals such as brass (B) and Zinc (Z).

Note 2. *Classification.* The conditions of exposure and use of plated steel are so varied that it is not possible to predict the average life of articles plated in accordance with Type KS or Type QS, or to predetermine just which type of plating should be specified for a given article. Such a selection must be based upon the experience of the manufacturers and users.

It is recognized that uses exist for which thicker coatings than those of Type KS will be required.

For articles that are intended for a short period of use, no standard specification for plating is recommended. It is suggested, however, that subject to the prevailing manufacturing conditions, certain minimum requirements be mutually agreed upon in order to insure that the plated coatings render a useful service.

Note 3. *Salt Spray Test.*

(a) *Preparation.* The specimen shall be cleaned immediately

before insertion in the salt spray, so that the surface is free from "water break". This may be accomplished by any efficient method such as cleaning with a suitable organic solvent followed by light rubbing with a cream of pure magnesium oxide.

(b) *Operation.* The test shall be conducted with a 20 per cent solution of sodium chloride (specific gravity 1.15) under conditions that produce a dense fog throughout the container, without the spray being blown directly against the specimens. The latter shall be supported by glass or other insulating material. The temperature in the box shall be kept by thermostatic control at 95 degrees ±5 degrees F. (35 degrees ±3 degrees C.). (This is about the lowest temperature that can be maintained throughout the year without artificial cooling.) The solution formed by condensation of the spray should be drained off and not used again.

Appendix A

Time Required for Plating. Any specified average or minimum thickness of plating can be produced consistently only if the current density and time of plating are controlled. Regulation of the voltage is of no value except so far as it produces the desired current density.

The current and time required to produce a certain minimum thickness of any metal will depend upon the shape of the article, the shape and position of the anodes, and the throwing power of the solution. General experience indicates that average thicknesses of at least 0.001 in. and 0.0005 in. will usually be required to produce the respective minimum thicknesses of 0.00075 in. and 0.0004 in. of nickel plus copper. For complicated shapes, longer periods will be required, which must be determined by trial. When a large number of small articles are plated simultaneously (for example, on racks or in barrels) the time of plating must be increased to insure the specified thickness on those articles that receive less than the average current density.

(a) *Copper and Nickel.* To deposit an average thickness of 0.001 in. of either of these metals in acid baths with 90 per cent efficiency, requires about 21 ampere hours per square foot. In the cyanide copper bath only about 10 ampere hours per square foot are required if the efficiency is over 90 per cent. Practically,

however, the efficiency in cyanide baths may be only 50 to 70 per cent, so for illustration the above figure of 21 ampere hours per square foot will be retained for all the copper layers.

The losses in buffing may vary from 10 to 20 per cent. If the latter value is assumed for safety, this will necessitate the use of 21 + 4 = 25 ampere hours (1500 ampere minutes) per square foot to yield an average thickness of 0.001 in. of copper plus nickel on the finished articles. This is equivalent to a total of one hour's plating at 25 amperes per square foot, 2.5 hours at 10 amperes per square foot, or to a corresponding period for any other current density. For an average thickness of 0.0005 in., half these periods will be required.

(b) *Chromium.* In chromium plating, bright deposits are usually produced with a cathode efficiency of about 12 per cent. Under these conditions it requires about 500 ampere minutes per square foot to produce the specified average thickness of 0.00002 in. of chromium. This is equivalent to 5 minutes plating at 100 amperes per square foot, or to 2.5 minutes at 200 amperes per square foot.

American Electro-Platers' Society

Convention and Exhibition

June 10 - 13, 1935

Bridgeport, Conn.

CONVENTION NOTES!!

Registration: The Committee would like to have the members and visitors coming to the Convention to register as soon as possible on their arrival. Those that arrive on Sunday, June 9th, will find some member of the Committee on hand at the Stratfield Hotel to take care of their registration.

Registration Fee: Ladies $4.00, Gentlemen $6.00.

Members and visitors who plan to come by rail should make sure at the time they purchase their railroad tickets to obtain a certificate which entitles them to the reduction on their return trip ticket (provided one hundred use it.)

Hotels: Headquarters for the Convention are at the Stratfield

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*For many articles the minimum thickness of chromium is more significant, but the average thickness has been specified pending the development of satisfactory methods for measuring the minimum thickness.

Hotel located on Main Street where members and visitors will register on arrival. Bridgeport's many excellent hotels insure adequate and comfortable hotel accommodations for permanent as well as transient guests. Bridgeport's largest hotel—The Stratfield—is operated on a metropolitan scale. The Barnun Hotel was erected in 1928 and is thoroughly modern as to accommodations and service. There are two other first-class hotels. The total number of rooms available is approximately 1400. The rates are as follows:

STRATFIELD HOTEL (475 Rooms)

Single rooms with bath	$3.00 — $3.50 — $4.00
Double rooms with bath,	5.00 — 5.50 — 6.00 — $7.00

BARNUM HOTEL (200 Rooms)

Tub and Shower		*Shower*		*Without Bath*	
1 person	$3.50—$4.00	1 person	$3.00—$3.50	1 person	$2.50
2 persons	5.00— 6.00	2 persons	4.50— 5.00	2 persons	4.00

STRATFIELD ANNEX (125 Rooms)

Single Room without bath, $1.50—Double, without bath, $2.50
Single Room with bath, $2.00, $2.50—Double, with bath, $3.50

All hotels are within five minutes walk of each other, centrally located, two short blocks from railroad station and a few short blocks off the main highway U. S. Route No. 1.

Due to the large attendance expected at this Convention, the Committee requests that you make reservations as soon as you decide to attend, in which case you will be more certain to reserve the kind of rooms you may choose. Rooms will be allotted in the order that the reservations are received. Chairman of the Hotel Committee is George J. Karl, 126 Manhattan Avenue, Bridgeport, Conn.

Program: The members and visitors all are assured of a program of papers so diversified that these papers cover the greatest number of branches of the electro-plating field that is possible. The complete paper program is enclosed herein.

PROGRAM

A. E. S. 1935 Convention

Monday, June 10.

8:30 A.M. Registration, HOTEL STRATFIELD.

9:00 A.M. Welcoming of delegates, members, and visitors
Ray O'Connor, Chairman, General Committee:
Joseph Sexton, President, Bridgeport Branch
Welcome to Bridgeport, Mayor of Bridgeport.
Opening Session, Charles H. Proctor, presiding, Founder A. E. S., 1909.

Presidential Address — "The A. E. S.", H. A. Gilbertson.

Business Session. Presentation of Credentials, Submission of amendments to constitution.

1:30 P.M. EDUCATIONAL SESSION—MOSQUE TEMPLE
William Phillips, presiding, Chairman, Research Committee.

1. "The Manufacturer and the Plater"—A. P. Munning, Hanson Van Winkle Munning Co.
2. "Report of Research Work"—Dr. William Blum, U. S. Bureau of Standards; Paul W. Strausser, A.E.S. Research Associate.
3. "The Effect of Different Acids on Cold Rolled Steel"—E. T. Candee, Chief Chemist, American Metal Hose Co., Waterbury, Conn.
4. "The Adhesion of Electrodeposits"—Walter R. Meyer, Research Chemist, General Electric Co., Bridgeport, Conn.

Tuesday, June 11.

9:00 A.M. HOTEL STRATFIELD, NEW ENGLAND SESSION

Thomas H. Chamberlain, presiding.

1. "Black Nickel Plating"—Joseph Downes, Remington-Rand Inc., Middletown, Conn.
2. "Plating Antimonial Lead"—Clarence Hemle, Walter R. Meyer, General Electric Co., Bridgeport, Conn.
3. "Barrel Finishing, Plating and Burnishing"—William Delage, The Oakville Division, Scovill Mfg. Co., Oakville, Conn.
4. "Spotting Out of Plated Cast Iron"—Walter W. Rowe, North and Judd Co., New Britain, Conn.
5. "Electroplating Zinc Base Die Castings"—Charles Costello, C. Cowles Co., New Haven, Conn.
6. "Coloring of Metals"—Harry MacFadyen, Arrow-Hart-Hegeman Electric Co., Hartford, Conn.

7:45 P.M. HOTEL STRATFIELD.

Dr. William Blum, presiding.

1. "The Mechanism of Electroplating"—Dr. Hiram S. Lukens, University of Pennsylvania, Philadelphia, Pa.

2. "Spectrograph Analysis as Applied to Electroplating"—Dr. D. T. Ewing, Michigan State College, Lansing, Mich.
3. "X-ray Diffraction of Metals"—Dr. H. R. Isenburger, St. John X-ray Laboratories, Long Island City, N. Y.
4. "Measuring Thickness of Electrodeposits with a Microscope"—Dr. Carl Heussner, Technical Director The Chrysler Corporation, Detroit, Mich.

Wednesday, June 12.

7:45 P.M. MOSQUE TEMPLE.

President H. A. Gilbertson, presiding.

1. "Air Conditioning of Plating, Buffing, and Lacquering Rooms"—A. W. Knecht, Consulting Engineer, Graybar Building, New York, N. Y.
2. "Brightening up the Plating Room"—J. A. Coolahan, Hercules Powder Co., Wilmington, Delaware.
3. "Why Metals Corrode"—Dr. Robert A. Burns, Assistant Chief Chemist, Bell Telephone Laboratories, New York, N. Y.
4. "Methods for Prevention of Season Cracks of Brass in Electroplating"—B. J. McGar, Assistant Chief Metallurgist, The Chase Companies, Waterbury, Conn.

Thursday, June 13.

9:00 A.M. STRATFIELD HOTEL

Thomas A. Slattery, Vice President A.E.S., presiding.

1. "Electrodeposition of Tin"—E. A. Shields, Chief Metallurgist, Westinghouse Electric and Manufacturing Co., Springfield, Mass.
2. "Optimum Metal Concentration of Nickel Solutions"—Dr. D. A. Cotton, Chief Research Engineer, Delco-Remy Corporation, Anderson, Ind.
3. "The Relative Value of Accelerated Corrosion and Outdoor Exposure Tests"—Dr. William Blum, Chemist, U. S. Bureau of Standards, Washington, D. C.
4. "Adventures in Electroplating Copper from Ammoniacal Solutions"—Dr. E. A. Vuilleumier, Dickinson College, Carlisle, Pa.

Plant Visitation Day: In the morning members and visitors will have their choice to visit either the plant of the Bridgeport Brass Co. or the Stanley Works. In the afternoon, those that desire will have an opportunity to visit the plant of the International Silver Co., in Meriden, Conn.

The International Silver Company is probably the largest silver manufacturing company in the world. They manufacture flatware and hollowware. They make a diversified line of table silver, trophy cups — anything and everything in the silver line. This will be an opportunity of a lifetime to see this largest silver manufacturing plant, to go through it and see the different processes it takes to fabricate and finish the different items in the silver line.

OFFICIAL PROGRAM WILL SHORTLY BE MAILED TO ALL MEMBERS OF THE SOCIETY.

Recreation — Social Events: Monday night, the International Fellowship Club will hold its Goodwill Party and Dance. Needless to say, those that attend will certainly enjoy the entertainment and dance.

Tuesday afternoon will be devoted to recreation and relaxation at the Seven Gables Inn. A buffet lunch and later a shore dinner will be in order — also a series of athletic events, games for the ladies, and the annual baseball game between the eastern and western baseball teams. Those western boys had better shellac up their bats, because they will run into strong competition when they meet the eastern team.

The big event, of course, will be the banquet Thursday evening at the Stratfield Hotel, with a fine program of entertainment and afterwards the dance. Nothing has been neglected or spared to make this an evening of pleasure long to be remembered. A menu has been selected which should appeal to everyone.

Ladies: The ladies will not have a dull moment while they are here. Their program is as follows:

Monday afternoon — Visit velvet and lace manufacturing plants.
evening — International Fellowship Club.

Tuesday morning — Open
afternoon — Shore Dinner, Seven Gables; games.
evening — Theatre.

Wednesday — All day bus ride, New Haven, Yale University.
Lunch at "The Oasis." Ride through the Naugatuck Valley.
evening — Card Games, etc., Stratfield Hotel.

Thursday morning — Sightseeing
afternoon — Lunch and fashion show at "Read's".
evening — Banquet (Hotel Stratfield).

Golf: Members and visitors that wish to play golf have the choice of two fine 18-hole courses to play on, both short ride from the hotels.

The Mill River Country Club was kind enough to extend the hospitality of the club any day during the Convention — nominal greens fee $1.00 for all-day playing.

The Municipal Golf Course, "Fairchild Wheeler" Course, a fine new course, is also available to the visitors at any time.

Exhibit: There are still a few booths available to those firms that wish to exhibit at the Exhibition Hall — the "Mosque Temple." About 85% of the spaces have been sold to date and it is suggested that as the few remaining booths will no doubt be taken shortly, those planning to exhibit should contract for space at once. Write to R. T. Phipps, Manager of Exhibitions, 271 Grovers Ave., Bridgeport, or telephone — Home 'phone 3-5207; Business 5-4151. In fairness to those who have made our exhibition possible, the Committee requests that there be no exhibits of any kind shown in hotel rooms. Those friendly towards the aims of the Society will abide by this ruling.

Tercentenary Year: Connecticut will celebrate her Tercentenary during the year 1935. Thousands of people are coming to take advantage of this notable event. Yes, they are coming to see and to learn more about the beauties and grandeur of Connecticut's scenery, climate and home life, her great manufacturing industries, business, commercial and educational institutions, and her many beautiful, peaceful and inspiring places for religious worship. They are coming to enjoy the invigorating ocean waters that crash on the inviting sandy beaches for miles and miles along Connecticut's beautiful shore line, to dip in the blue refreshing waters of her inland lakes and sparkling rivers, to view her rugged hills, winding valleys and explore her enticing woodlands. Plan to spend your summer vacation of 1935 in Connecticut, the land teeming with so many beneficial diversified resources.

Presented before the Faraday Society, London, England.
By DR. WM. BLUM

Structure and Properties of Nickle Deposited at High Current Densities[1]

[1]Publication approved by the Director, National Bureau of Standards, Washington, D. C.

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I. INTRODUCTION.

During the past fifteen years, the National Bureau of Standards of the United States has co-operated with the Bureau of Engraving and Printing in the development of electrolytic methods for the reproduction of engraved plates used for printing currency (2, 10),[4] In the process now in use, the initial deposit (or printing

[4]The numbers in parentheses refer to the bibliography at the end of the paper.

face) consists of a nickel layer about 0.25 mm. thick, upon which sufficient iron is deposited to make a finished thickness of about 5 mm. Chromium is subsequently applied to the printing surface. The nickel is deposited at about 2 amp./dm^2 and the iron at about 7 amp./dm^2. Under these conditions the total period of deposition is about ninety-six hours.

The occasional need for more rapid deposition, especially in the initial printing of a new series of currency, led to an investigation that is still in progress, upon the possibility of depositing iron and nickel much more rapidly. This paper is devoted to the structure and mechanical properties of some of the nickel deposits produced in this study. The practical application of very high current densities involves the solution of operating problems that will be discussed in a subsequent publication. All the deposits referred to in this paper are distinctly experimental.

II. REVIEW OF LITERATURE.

Much less research has been conducted on the structure of nickel than of copper deposits, and very little upon nickel deposits produced at high current densities. It was early shown by O. P. Watts (1) that nickel can be deposited at much higher current densities than were (or are) used commercially. He obtained "good" deposits at about 30 amp./dm^2., and in one experiment he applied 95 amp./dm^2. for one minute and obtained "fine" metal. His deposits were relatively thin (from 0.03 to 0.08 mm.) and he made no quantitative physical measurements.

In 1921, it was reported by W. Blum (3) that nickel deposits from sulphate solutions containing fluoborate were stronger, harder, and less ductile than those from similar solutions containing chloride. The "chloride" deposits had a coarse, conical grain structure, while the "fluoborate" deposits had a fine, fibrous structure.

C. P. Madsen (4) reported that ductile nickel could be produced by lifting the cathode from the bath at frequent intervals. He thereby obtained nickel deposits with a tensile strength of 5000 kg./cm^2. and a Brinell number of 130, that could be drawn into wires.

In 1925, C. T. Thomas and W. Blum (6) made scratch-

hardness measurements on a few nickel deposits produced at relatively low current densities. They found that the hardness was increased by raising the current density or the cathode polarisation; and was decreased by raising the temperature or by using a bath composed entirely of nickel chloride instead of the customary sulphate.

W. M. Phillips (12) reported that an increase in temperature in baths having either a high or a low pH reduced the scratch-hardness of the deposits.

The most extensive studies upon the structure and properties of nickel deposits have been made in recent years by D. J. Macnaughtan and his associates (5, 7, 8, 11, 13, 14). They determined the effects of adding various substances to nickel sulphate baths and of changing the pH of the solutions. Most of their deposits were produced at 35° C. at a current density of 1.2 amp./dm^2. They found that in all of the solutions used, fine-grained, hard deposits were obtained at a high pH (of 5 to 6), and that the hardest deposits were produced in solutions containing ammonium salts. As the pH was progressively lowered in solutions containing chlorides, the hardness decreased and then remained nearly constant. In such solutions, potassium salts produced harder deposits. In solutions free from chlorides, as the pH was lowered, the hardness successively decreased, increased and decreased. In these solutions, potassium salts decreased the hardness.

Macnaughtan (13, 14) and also O'Sullivan (9) concluded that the hardness of nickel deposits is associated with the inclusion of nickel oxide or hydroxide.

III. SCOPE OF THIS INVESTIGATION.

This investigation was devoted to the study of nickel deposits produced at current densities of at least 20 amp./dm^2. The purpose was to deposit rapidly nickel that is relatively ductile and free from strains. Great hardness or wear resistance is unnecessary, as the printing plates are coated with chromium. Decided roughness is objectionable, as it causes still more roughness of the iron that is deposited upon the initial layer of nickel. Freedom from pits in the nickel face is important.

IV. EXPLORATORY EXPERIMENTS.

Commonly accepted theories of nickel deposition indicated that the above requirements might be met with concentrated nickel solutions at a low pH and a high temperature. To test this prediction, numerous experiments were made upon a small scale, with visual and manual examination of the deposits. The results of these qualitative tests may be summarized as follows:

As the buffer curves of all nickel solutions (except those containing fluorides) have a very steep slope between pH 5 and 2, it is difficult to maintain a specified pH between those limits for the long periods required for thick deposits. Practically all the tests were made at a pH of 2 or less, as it was found that at a pH of 5 or higher the deposits at very high current densities were cracked and brittle.

The best results were obtained at the boiling-point of the solution (about 102° C.). At this temperature there was no pitting of the deposits in any of the solutions. In baths with a high pH at high current densities, pitting sometimes occurred almost up to the boiling-point, but in baths with a low pH, it usually disappeared at about 90° C.

If, as is often assumed, a high concentration of nickel ions is necessary for rapid deposition of nickel, nickel chloride should be superior to the sulphide. It was found, however, that deposits from nickel chloride solutions were invariably more brittle than deposits from sulphate baths with the same pH. The brittleness of the chloride deposits appeared to increase with current density. Additions of boric acid or of phosphoric acid to buffer the nickel chloride had no pronounced effect. Ammonium chloride increased the hardness (as reported by Macnaughtan for sulphate baths), while calcium chloride had little effect. Fluorides or fluoborates could not be used in the boiling solutions because a precipitate, probably of nickel oxyfluoride, separated.

Nickel sulphate baths with a pH of 1 or less yielded relatively soft, ductile nickel deposits at current densities from 10 to 200 amp./dm^2., with an apparent increase in ductility as the current density was raised. An increase in the pH of the solution from 1 to 2 hardened the deposits, while addition of boric acid to the bath softened them. Unsuccessful attempts were made to produce

soft nickel from sulphate solutions whose conductivity had been increased by adding various substances. The addition of ammonium sulphate to the bath increased the hardness (as found by Macnaughtan). With sodium sulphate there was not much increase in hardness, but the increase in polarization offset the increase in conductivity.

The embrittling effect of chloride persisted in baths containing both sulphate and chloride, especially at a low pH. No difference was found in these qualitative tests, whether commercial nickel salts of good quality or highly purified salts were used. Evidently, the effects of impurities are insignificant in highly acid solutions under these conditions.

V. QUANTITATIVE TESTS.

1. Preparation for Plating.

A few typical conditions were selected for quantitative measurements. These conditions were limited to those under which fairly smooth, flat deposits about 8 by 20 cm. and 0.6 mm. thick could be produced and separated from the base metal. A further limitation was the capacity of the available generator, namely 250 amperes at 12 volts.

(*a*) *The Base Metal.*—For each experiment a rectangular polished steel plate 8 by 20 by 0.5 cm., was plated on both sides with an adherent coating of nickel about 0.025 mm. thick in a regular plating bath[5] and was then buffed.

(*b*) *Separation of the Deposit.*—The hot, acid nickel solutions immediately removed the passive film produced on polished nickel by chromic acid or by anodic treatment in alkali. Even the thin film of graphite that is often used to promote separation was so completely removed by such solutions that the deposits were firmly adherent. The following procedure resulted in deposits that could be separated. The polished nickel surface was rubbed with a graphite suspension, rinsed and then coated with about 0.01 mm. of nickel in the regular nickel bath at about 20° C. and 0.8 amp./dm^2. The plate was then rinsed and transferred to the hot bath, in which the desired thickness (about 0.6 mm.) was deposited. When the edges of the plate were ground, the deposit could readily be removed from each side.

[5]This bath contained 1.4 *N* $NiCl_2$ and 0.5*N* H_3BO_3, and was operated at pH 5.3 at 35°C and 2 amp./dm^2.

It should be noted that each of the specimens tested was therefore a composite, of which the initial 2 per cent. was deposited from an ordinary nickel bath.

2. Operating Conditions.

(*a*) *Bath Composition.*—The baths listed in Table II were prepared from commercial nickel salts without further purification. Chemical analysis of the filtered solutions detected only the impurities shown in Table I, in amounts which have also been computed for the solid salts.

TABLE I.—Impurities in Nickel Solutions.

	N Nickel Chloride.		*N* Nickel Sulphate.	
	g./l.	Per Cent of Solid Salt ($NiCl_2.6H_2O$).	g./l.	Per cent. of Solid Salt ($NiSO_4.7H_2O$).
Copper	0.030	0.006	0.011	0.002
Iron	.005	.001	.006	.001
Lead	.010	.002	none	none
Zinc	none	none	.006	.001

The pH values were determined at room temperature with a quinhydrone electrode. They were kept constant during an experiment to within $\pm$ 0.1 pH, except in one sulphate bath (Set 12). This was started at a pH of 2, but rapidly dropped to 1.6, in spite of additions of nickel hydroxide.

(*b*) *Anodes.*—Elliptical rolled anodes of so-called "depolarized nickel" were used, with an exposed area slightly larger than that of the cathode. Numerous analyses of similar anodes showed that they contain considerably over 99 per cent. of nickel (plus cobalt), and a small amount of nickel oxide, with less than 0.1 per cent. of copper or 0.25 per cent. of iron. They were surrounded with heavy asbestos bags. They corroded with high efficiency in all the baths except the sulphate bath (Set 12) above referred to. Their rapid consumption caused the liberation in the bags of considerable sludge, which increased the resistance of the bath during the latter part of each run.

(*c*) *Temperature.*—The temperature was raised to the boiling-point by preliminary passage of current, and was maintained during a run by regulating the amount of asbestos packing around the jars. At the highest current densities, additions of

cold water to the bath (replacing the losses by evaporation) were required to prevent too rapid boiling.

(*d*) *Electrode Spacing.*—The deposition was conducted in 5-liter glass jars, each 12.5 by 17 by 24 cm. deep. The cathode was 5 cm. from each of two anodes. Uniform distribution of the deposit is essential for reliable measurements of tensile strength. By placing glass plates close to each vertical edge of the cathode, the lateral distribution was made nearly uniform, but the deposit was usually about 10 per cent. thicker at the top than at the bottom.

(*e*) *Cathode Efficiency.*—Accurate measurements of cathode efficiency with a copper coulometer were precluded by the large-sized copper cathode that would be required for the high currents used. Results based on the total weight of the deposit were subject to errors caused by the frequent formation of "trees," some of which dropped off during deposition. The reported efficiencies are based on the measured thicknesses in the reduced sections of the tensile specimens, where approximately the average current density prevailed. The accuracy of the efficiency measurements was probably not better than $\pm$ 5 per cent.

3. Methods of Test.

(*a*) *Tensile Strength and Ductility.*—Two rectangular specimens, 20 by 2 cm., were cut from each deposit after it was removed from the base metal. Each specimen was then machined to produce a reduced section 1.24 cm. wide and 6 cm. long. A number of penciled gage-marks were made at intervals of 1.25 cm. The gage length of 5 cm. that was most nearly symmetrical with the fracture was subsequently selected in measuring the elongation.

Preliminary observations showed that the average thickness computed from the weight of a rectangular specimen agreed within about 1 per cent. with that based on micrometer readings. The latter showed that the thickness towards the top was as much as 10 per cent. greater than that near the bottom, which difference corresponded to an average variation of about 3 per cent. within the gage length. A number of micrometer readings were taken in each reduced section, and the tensile strength was computed from the thickness where fracture occurred rather than from the minimum thickness. These two thicknesses

agreed within about 2 per cent. for most of the specimens tested.

The testing machines were chosen to suit the thickness and strength of the specimens. Most of the tests were made on a machine with an adjusted capacity of 900 kg., but a few were made on machines with capacities of 2300 and 270 kg.

(*b*) *Hardness.*—Four strips were cut from each specimen immediately adjacent to the strips used for tensile tests. Most of the hardness measurements were made upon the back (surface last deposited), which was lightly ground with emery paper to produce a suitably smooth surface. A few tests were made on the front surface, both as deposited and after the initial or starting layer had been ground off. These measurements agreed closely in all cases with those on the back of the deposits.

The Brinell tests were made in a Rockwell Superficial Hardness Tester, in which a ball 1.6 mm. (1/16-inch) in diameter was applied under a load of 15 kg. for 30 seconds. The diameters of the resultant impressions were measured with a micrometer microscope to $\pm$ 0.01 mm., which corresponds to a difference of about 7 units in the softer specimens (with about 125 Brinell number) and about 17 units in the harder specimens (with about 225 Brinell number). The results reported in Table II are the averages of at least six concordant measurements on each deposit, after a very few discordant results had been excluded.

About half of the deposits were also tested in the Vickers Hardness Tester with a square diamond pyramid having a solid angle of 136 degrees. Loads of 10 and 30 kg. were applied, but with the 30 kg. load the indenter nearly penetrated some of the specimens. The results reported in Table II are based only on a 10 kg. load.

(*c*) *Structure.*—Two pieces adjacent to the centres of the tensile specimens were cut from each deposit. These were clamped together and the edges were ground flat, polished wet with successively finer abrasives, and finished with magnesium oxide on velvet. They were then etched with glacial acetic acid to which just sufficient concentrated nitric acid (less than 1 per cent.) was added to cause attack of the metal. Etching and polishing with magnesia were repeated until all grinding flowmarks were eliminated. The surface was then wiped with a light mineral oil, which produced more contrast when the structures were photographed, especially at 500 diameters.

VI. RESULTS.

1. Reproducibility and Significance of the Measurements.

(*a*) *Ultimate Tensile Strength.*—The results with two specimens cut from the same deposit invariably agreed within 3 per cent. Specimens from similar deposits produced in separate runs agreed within about 5 per cent. The results reported in Table II are the averages of at least two, and usually four, specimens, with no results excluded.

TABLE II. PROPERTIES OF ELECTRODEPOSITED NICKEL[1]

Set No.	Solution. $NiCl_2$. N.	$NiSO_4$. N.	H_3BO_3. M.	pH.	Current Density, amp./dm².	Time, Hr.	Thickness, mm.	Cathode Efficiency, Per Cent.	Ultimate Tensile Strength, kg./cm².	Elongation in 5 cm. Max. Per Cent.	Elongation in 5 cm. Av. Per Cent.	Hardness Number. Brinell	Hardness Number. Vickers.	Structure Type.	Surface Type.
1	4	—	—	1	22	3	0.54	65	6400	8	8	178	—	fine	smooth
2	4	—	—	1	30	2	.63	85	7100	8	6	227	201	fine	smooth
3	4	—	—	1	45	1.6	.72	100	7400	8	7	196	195	fine	smooth
4	4	—	—	2	30	2	.64	85	6800	7	6	219	—	fine	smooth
5	4	—	0.7	1	30	2	.64	85	6700	6	6	194	186	fine	smooth
6	1	3	—	1	30	2	.54	70	6200	18	12	171	172	fine	smooth
7	1	3	0.7	1	30	2	.54	70	7100	8	8	195	—	fine	smooth
8	—	4	—	1	22	5	.77	55	4100	24	23	127	—	coarse	rough
9	—	4	—	1	30	2	.43	55	4400	23	19	123	118	coarse	rough
10	—	4	—	1	30	3	.63	55	4200	26	25	124	—	coarse	rough
11	—	4	—	1	42	0.7	.23	65	4800	9	9	122	—	coarse	rough
12	—	4	—	1.6	30	2	.53	70	4600	5	5	170	—	coarse	rough
13	—	4	0.7	1	30	3	.66	60	3800	13	13	117	116	coarse	rough

[1]All deposits were produced at approximately 100° C.

(*b*) *Elongation.*—Most of the specimens had at least a few visible nodules on the surface. In general (Table II), there were more nodules on the deposits from sulphate than from chloride baths. An effort was made to cut each specimen so that none of these nodules were at the edges of the reduced section. However, it was evident that fracture often occurred where a nodule was present. The very good reproducibility of the tensile tests indicates that the nodules had no marked effect on the tensile strength. However, the presence of nodules undoubtedly reduced the ductility and led to less concordant results for the elongation. As the nodules would always tend to decrease the elongation, the maximum values in Table II probably represent more truly the ductility of the metal than do the average values.

(*c*) *Hardness.*—In almost every case, the Brinell and Vickers numbers agreed within the probable accuracy of the measurements.

(*d*) *Structure.*—The structure of two or more pieces of each deposit were so similar that any one of them could be considered typical. The structures are of two principal types.

2. Effects of each Variable.

(*a*) *Chloride versus Sulphate.*—The data reported in Table II show that the deposits are in two widely different classes. Those obtained from nickel chloride solutions have a fine-grained structure and are relatively smooth, strong, hard and brittle, while the corresponding deposits from the sulphate baths are rough, coarse-grained, soft and ductile. The presence of only 25 per cent of nickel chloride in the sulphate baths (Sets 6 and 7) makes the deposits almost the same as those from pure chloride solutions. This is the one outstanding conclusion of this study, and fully confirms the preliminary qualitative tests.

(*b*) *Current Density.*—It is more difficult to determine which other variables had definite effects. Comparison of the tensile strengths in Sets 1, 2, and 3 indicates a small increase as the current density was raised, with no corresponding change in elongation. Sets 1 and 2 show an increase in Brinell number, which, however, is not continued into Set 3.

In the sulphate solutions the apparent effect of current density in increasing the tensile strength may not be definite, as the deposits (Sets 8, 9, 10 and 11) are not of the same thickness. The greater strength and lower ductility of Set 11 are partly due to

the lesser thickness of these specimens. The first part of each deposit (especially of those with coarse crystals) is finer-grained and presumably stronger than the part deposited later. It was necessary to use thin specimens for Set 11 because the maximum available voltage was required for this high-current density in the sulphate bath, and, in less than one hour's operation, the accumulation of sludge in the anode bags increased the resistance and reduced the current density below that specified. There is no perceptible effect of current density on the Brinell hardness, which is apparently less affected than is the tensile strength by the thickness of the deposits.

(*c*) *p H.*—Comparison of Sets 2 and 4 shows that a change in pH from 1 to 2 has no definite effect in chloride solutions. Sets 9 and 12 show, however, that in sulphate solutions an increase in pH from 1 to 1.6 (or initially to 2), reduces the ductility and increases the Brinell hardness.

(*d*) *Boric Acid.*—Comparison of Sets 2 and 5 shows that the addition of boric acid (sufficient to saturate the solution at room temperature) had no pronounced effect on the deposits in chloride solutions; while Sets 9 and 13 indicate a slight softening effect in the sulphate baths.

(*e*) *Cathode Efficiency.*—The approximate values show that the efficiency was always higher in chloride solutions than in corresponding sulphate baths. In the former solutions it increased decidedly with current density, but only slightly in the sulphate baths.

VII. CONCLUSIONS.

The most obvious conclusion of this investigation is the need for more exhaustive study of the deposition of nickel (and of other metals) over a very wide range of conditions before any complete theory of metal deposition can be developed. The need is also shown for more discriminating methods of examining deposits than the conventional metallographic and mechanical methods. It is hoped that the applications of X-rays and electron diffraction, to be discussed in this symposium, will help to meet this need.

Pending a more detailed study, including the range between the normal conditions and the extreme conditions here used, it would be futile to attempt to explain the above results. The difficulty of formulating a complete theory is emphasized by the

wide difference in the relative effects of chloride and sulphate ions under different conditions. It was found by Thomas and Blum (6) and by Macnaughtan, Gardam and Hammand (13) that at low temperatures and current densities, the presence of chlorides made softer deposits (which is consistent with the general experience of practical platers). However, at the high temperature and current density used in this work, the presence of chloride always resulted in harder deposits. It is obvious that any theory such as that advanced by Macnaughtan (13) to explain the softening effect of chloride ions would require radical modification to include the hardening effect here reported. Discussion of this and other possible theories will therefore be reserved until more data are available.

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VIII. BIBLIOGRAPHY.

(1) "Rapid Nickel Plating," O. P. Watts, *Trans. Am. Electrochem. Soc.*, 1916, **29**, 395.

(2) "The Electrolytic Reproduction of Engraved Printing Plates," W. Blum and T. F. Slattery, *Chem. Met. Eng.*, 1921, **25**, 320.

(3) "The Use of Fluorides in Solutions for Nickel Deposition," W. Blum, *Trans. Am. Electrochem. Soc.*, 1921, **39**, 459.

(4) "Ductile Electrolytic Nickel," C. P. Madsen, *Trans. Am. Electrochem. Soc.*, 1921, **39**, 483.

(5) "The Hardness of Electrodeposited Iron, Nickel, Cobalt and Copper," D. J. Macnaughton, *J. Iron Steel Inst.*, 1924, **109**, 409.

(6) "The Protective Value of Nickel Plating," C. T. Thomas and W. Blum, *Trans. Am. Electrochem. Soc.*, 1925, **48**, 69.

(7) "The Hardness of Electrodepsoited Nickel," D. J. Macnaughton and A. W. Hothersall, *Trans. Faraday Soc.*, 1928, **24**, 387.

(8) "Hardness and the Polishing of Electrodeposits," D. J. Macnaughton and A. W. Hothersall, *J. Electroplaters' and Dep. Tech. Soc.*, 1929-30, **5**, 63.

(9) "Studies in the Electrodeposition of Nickel. Part I. The Effect of pH and of Various Buffering Agents; the Presence of Oxygen in the Deposits," J. B. O'Sullivan, *Trans. Faraday Soc.*, 1930, **26**, 89.

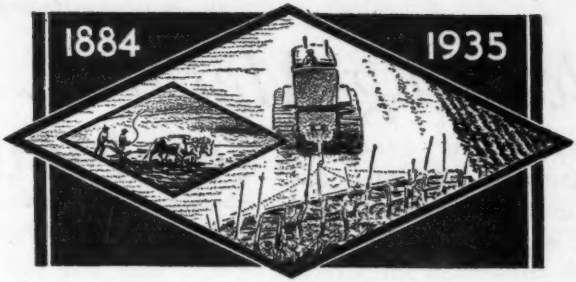
(10) "The Production of Electrolytic Iron Printing Plates," C. T. Thomas and W. Blum, *Trans. Am. Electrochem. Soc.*, 1930, **57**, 59.

(11) "The Influence of the Acidity of the Electrolyte on the Structure and Hardness of Electrodeposited Nickel," D. J. Macnaughtan and R. A. F. Hammond, *Trans. Faraday Soc.*, 1931, **27**, 633.

(12) "Further Developments in Low pH Nickel Deposition." W. M. Phillips, *Trans. Am. Electrochem. Soc.*, 1931, **59**, 393.

(13) "The Influence of the Composition and Acidity of the Electrolyte on the Characteristics of Nickel Deposits," D. J. Macnaughtan, G. E. Gardam and R. A. F. Hammond, *Trans. Faraday Soc.*, 1933, **29**, 729.

(14) "The Effect of Annealing on the Microstructure and Mechanical Properties of Electrodeposited Nickel," G. E. Gardam and D. J. Macnaughtan, *J. Electrodep. Tech. Soc.*, 1933-34, **9**, 27.



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ZAPON LACQUERS

Cleaning Metals for Plating

By D. W. ROBINSON
Ilion, New York

CLEANING as understood generally by Platers and workers in metals consists in removing oils, greases, and other substances and foreign matter held to the metal surfaces by the grease or oil.

The first common method of cleaning metals is by converting the grease or oil into soap which is then dissolved in the cleaning solution.

This is called saponification and is a chemical process, a reaction taking place between the oil and grease and the cleaning agent in which soap is formed as the cleaning is accomplished.

The second common method of cleaning metals is mechanical and does not change the oil or grease, but does break it up into microscopically small particles which are held in suspension by the cleaning solution.

In the case of mineral oil which is more commonly used in processing metals and parts manufactured from the metals, we find that this oil will not saponify, nor is it soluble in such cleaners as are in themselves water soluble.

Therefore, to remove such oils from metal surfaces we must emulsify them.

Vegetable oils such as Castor Oil, Cotton Seed Oil, Cocoa Tallow etc., are readily saponified as well as emulsified.

This is true of animal oils also, such as true Lard Oil, Animal Tallows, etc. Emulsification then, is one of the best and cheapest methods of cleaning metals wherever it is possible to use it, for at least two reasons. First, it takes little chemical strength from the cleaning solution. Second, where large quantities of oil are removed in this way, the oil may be easily separated and recovered for further use and the continued use of the cleaning solution assured.

It is evident, however, that in actual practice no one cleaning solution or compound will at all times and under all conditions effectively remove, either by simple saponification or emulsification every sort of grease, oil, and dirt.

The plater then must determine for himself and adopt for effective results the proper cleaning agents for his particular problem of metal cleaning.

Emulsification and saponification are both aided by properly heating the solution, 180° F to boiling temperature assisted by gentle agitation helps wonderfully in the removal of grease and dirt. For cleaning steel and iron parts which are not attacked by the stronger alkalies, Caustic Soda and Soda Ash mixtures are preferable, especially when work is to be cleaned in bulk as in barrel plating, etc. This mixture may be varied and proportion of Caustic to Soda Ash increased or decreased to suit the case as may be desired.

A good solution for cleaning work for barrel plating is as follows:—

Water, 1 gal.
Soda Ash, 6 oz.
Caustic Soda, 2 oz.

This is not suitable for work which has soldered or tinned parts. Such parts should be cleaned in a cleaner which does not readily attack solder or tin. Such a cleaner by analysis is composed of Sodium silicate 38.20%, Caustic Soda 23.40%, Soda Ash 19.20%, Moisture 19.20%. This should be used 8 oz. to each gallon of water, more may be used without any bad effect upon such work immersed not more than 20 minutes which will ordinarily clean almost any "hard to clean" parts. It is understood of course that the solution should be kept hot. 180°.

This cleaner does not readily tarnish brass and copper and has a considerable amount of insoluble material in it which has a scrubbing effect when boiling. This is very effective also in removing oils and dirt and does not require frequent replenishing.

This cleaner is sold on the market under various trade names, the only difference being in the proportions of the three Sodium Compounds.

Another effective cleaning solution used hot or boiling is composed as follows:

Water, 1 gal.
Soda Ash, 4 oz.
Caustic Soda, 2 oz.
Tri Sodium Phosphate. 2 oz.

This too may be varied to suit almost any requirement in cleaning, but a solution made up weaker than the above formula will not work well long.

This formula approximates very closely many proprietary cleaners now on the market. It is clear that much may be saved in cost of cleaning metals if attention is paid to eliminating "mystery" cleaners supposed to have extraordinary virtues, and getting the facts, which are these, that practically all the cleaners which are used in metal cleaningare composed of the same materials in varying proportions and that most if not all of the problems of cleaning may be solved by the plater himself when he is armed with this knowledge and willing to test out a number of these combinations.

ELECTRIC CLEANERS

Electric cleaning of parts has been likened to scrubbing, that is, the electric current passing in a weak hot alkaline bath causes the rapid forming of gas bubbles on the negatively charged parts, the first bubbles formed being pushed off by others the parts to be cleaned being connected of course, to the negative pole or rod the steel or cast iron tank forming the anode, or in some instances boiler iron or steel plates of suitable size are used as anodes.

Experience in using this very valuable method of cleaning has shown several things of which mention is here made. First, that in order to get the best results in cleaning by this method a suitable combination of the Sodium compounds must be used. Second, for best results the solution should be rather weak. Third, a comparatively high voltage and large anode surface must be used. Fourth, the hotter the solution is maintained the quicker and better the results. Fifth, the position of the work in the cleaning bath has much to do with the rapidity of cleaning, for example, if the work to be cleaned is suspended from the negative pole in such a manner that some portions are shaded or overlapped it is evident that it will not be cleaned as rapidly as when fully exposed to the action of the current.

Here, too, the matter of the proper density of solution comes in, experience showing that the weaker solution does the best work.

Much could be said along this line, but of course no hard and fast rules may be made as each man's problem must be met and solved in the most efficient way.

One of the best and simplest combinations for electric cleaner is as follows:

Water, 1 gal.
Soda Ash, 2 oz.
Caustic Soda, 1 oz.
Tri-Sodium Phos., 1 oz.

This may be modified to meet almost any problem of cleaning with the current.

It may be said in passing that where the electric cleaner is depended upon to do the greater part of the cleaning for plating etc., it has been found that fine results are obtained by the use of two cleaners with the necessary light pickle installed between the two cleaners with the cold or hot water rinse. When the two electric cleaners are used the parts are put directly into the first E.C. for a few seconds and then rinsed and light pickled and if stained given a cyanide dip and water rinse and then finish cleaned in the second electric cleaner, again rinsed thoroughly, and placed in plating vat, or copper strike. This method of cleaning is practically fool proof and may be depended upon, and as the worst of the grease and dirt are removed in the first cleaner, the second or last cleaner is always clean and ready to do a good job.

Much has been said in favor of the combination Electric Cleaner and Copper strike. In many cases this works well, but the difficulty seems to be in keeping it in condition to do good work because of the severe requirements. That is, to remove grease and dirt and copper plate at the same time.

Where there is much dirt and grease to be removed the solution soon takes into itself a large amount of foreign matter which adds to the density of the solution rendering it less active in cleaning.

Some use a switch cut in to reverse the current for a few seconds in the electric cleaner claiming some advantage by so doing, but the writer's experience has been that there is no advantage in this procedure.

Since the above was written, cleaners containing or made up

entirely of Sodium Metasilicate have come into common use. The writer finds them to be very satisfactory, especially in electric cleaning baths.

Vapor degreasing has its place now in preparing metal work for plating, its function seemingly being to remove the worst dirt and grease ahead of the regular cleaning operations in soaking tanks and electric cleaners. In some instances processing in this way does away with hand wiping on work which may not be washed in bulk, or which is difficult to clean on racks, etc. Films left on some classes of work after degreasing are hard to remove in the successive steps of soaking and electric cleaning, some times finger printing and shadow staining occur, which show up after parts are plated. This is the case where parts are polished on several wheels some of the grease and emery residue plus finger marks remaining. Of course this condition is not so marked if the parts are well washed previous to the final or finish polish.

It should be understood that the writer is referring generally to steel and iron parts in this article.

Maximum efficiency and economy in operating an alkaline cleaning bath calls for maintaining the constant cleaning value. This of course means control of the pH value. At present there are certain methods and indicators which may be secured which make this a comparatively simple matter.

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The Abstract Section

T. F. SLATTERY, *Chairman, Program and Educational Committee*

The Symposium of the Faraday Society of London on "The Structure of Metallic Coatings, Films and Surfaces"

PROGRAM AND EDUCATIONAL COMMITTEE

It has been the policy of the Faraday Society for a number of years to hold general discussions of topics of timely interest. The topic which was selected for general discussion this spring was "The Structure of Metallic Coatings, Films, and Surfaces". The meeting was held in London, England, on the twenty-ninth and thirtieth of March, and was attended by Dr. W. Blum of the National Bureau of Standards as an invited guest. A total of twenty-five papers were scheduled for presentation, of these twenty are available at the present time. A short sketch of these twenty will be given here. The papers that are of general interest to the electroplaters generally occur toward the end of the group. For further details consulting of the original papers is advised.

1. **"The Structure of Metallic Coatings of Films and Surfaces"**, Introductory paper by CECIL H. DESCH, D.Sc., F.R.S. A sketch is given of main topics to be discussed by the various other papers on the symposium.

2. **"An Apparatus for Electron Diffraction at High Voltages"**, by Professor G. P. THOMSON, F.R.S. A description of a high voltage apparatus for electron diffraction experiments.

3. **"Electron Diffraction and Surface Structure"**, by G. I. FINCH, A. G. QUARRELL and H. WILMAN. A detailed presentation of the apparatus employed in electron diffraction experiments, the methods of preparing thin foils for transmission work, the theory of behavior of electron beams on various materials (single crystals, oriented crystals, and polycrystalline materials). Definite evidence that crystals of electrodeposited metals are oriented is shown. Moreover, it is shown that the initial plate on polished surfaces is more amorphous than crystalline.

4. **"Inner Potentials of Crystals and Electron Diffraction"**, by W. E. LASCHKAREW. A theoretical discussion of the effect that a crystal is composed of electrically charged particles has upon the problem of electron diffraction. Also, as to how the method may be employed toward obtaining the magnitude of the fields effective in the interior of crystals.

6. **"The Thickness of the Amorphous Layer on Polished Metals"**, by H. G. HOPKINS, A.R.C.S., B.Sc. The question of the "Beilby layer", that is the existence of amorphous film, on the surface of polished metals has been definitely proved by electron diffraction methods. The proof here is that as a surface is polished the electron diffraction patterns become blurred, which is indicative that crystals do not exist on the surface. The main previous support was given by French. In the research presented a piece of polished gold was examined, and shown to have a truly amorphous structure. As successive layers of atoms were sputtered off the surface became

more and more crystalline. This fact being made obvious by the sharpness of the electron diffraction pattern. The truly amorphous layer in polished gold surfaces extends about 30 A° (one ten-millionth of an inch.) The crystal sizes, however, became larger as more metal was sputtered off. At 100 A° (three ten-millionths of an inch) the size of the crystals was only 5 or 6 atoms on edge. At 400 or 500 A° (twelve to fifteen ten-millionths of an inch) the crystal sizes were the same as for the unpolished metal. These changes were induced by four minute rubbing with 0000 emery paper, and fifteen minutes with chamois leather.

8. **"The Crystallization of Thin Metal Films"**, by Professor E. N. da C. ANDRADE. A study was made of extremely thin films of metal from 50 to 10 atoms thick. The metals studied were gold and silver, and prepared by sputtering. The films as prepared on a base of diamond, mica, and glass show evidence of crystals when examined by a polarizing microscope. On being allowed to stand at temperatures that even hundreds of degrees below the melting point the metallic films aggregate and form well defined crystals which are usually oriented with respect to the support.

9. **"The Validity of Drude's Optical Method of Investigating Transparent Films of Metals"**, by LEIF TROUSTAD. The Drude optical method of the study of film takes advantage of the change of plane of polarization of light off of a surface as means toward investigating the nature of that surface. It may be applied, for example, to the study of very thin oxide films that are found on metals, particularly when they are in the passive condition. The paper is a critical discussion of the theory underlying the method and sources of error that creep into it.

10. **"Optical Research on Evaporated Metal Layers"**, by L. S. ORNSTEIN. The work discussed is on the optical characteristics of thin metallic films, which have been prepared by evaporation and condensation of metals. If films of metal of different but known thicknesses are available it is possible to obtain the transmission and reflection spectra of thin films of metal. The metal promises to be a powerful one in the investigation of the structure of metals and the surface, particularly in the study of corrosion.

10a. **"The Structure of Polished Metal Surfaces"**, by C. S. LEES, B.A. The structure of a polished surface was investigated by means of electron diffraction. The metals studied were copper and gold. The surface was prepared by grinding with successive grades of emery and then polishing. The polished surface was examined by means of electron diffraction. Successive layers were removed electrolytically and the new surfaces were re-examined. The results show that for 30 A° (one ten-millionth of an inch) the metal was amorphorous. Then from 100 to 300 A° (three to nine ten-millionths of an inch) of tiny crystals two-thirds as large as those in the bulk of the metal, but with the difference that the polishing operation had induced an orientation of the crystals. Beyond that the metal was the same as in the unpolished condition. It was found that direction of orientation was not determined by the direction of polishing, but the plane of the polished surface.

11. **"The Determination of the Structure of Electrodeposits by**

Metallurgical Methods", by D. J. MACNAUGHTAN and A. W. HOTHERSALL. The surface appearance of an electrolytic deposit may at times be related to the actual micro-structure. Thus, deposits with a coarse columnar structure are in general visibly crystalline, those with a finer microstructure are matt, those with a very fine grain are lustrous or bright. However, this may be at times misleading. There is no definite relation (in nickel) between the cathode polarization and the type of deposit obtained. The authors recommend that a form of indentation hardness test, such as Brinell or the diamond pyramid test supplemented with tensile test measurement be used for the classification of electrolytic deposits. The examination of the microstructure of the initial deposit and that annealed at different temperatures and times can give valuable information as to the cause of the hardness. Thus in nickel the hardness is definitely associated with the existence of oxide, as definitely shown that on annealing at relatively low temperatures the recrystallization takes place normal to the plane of the deposit. The impurities in the crystal grains interfere with the recrystallization.

15. **"The Cathodic Film in the Electrolytic Reduction of Aqueous Chromic Acid Solutions"**, by ERICH MÜLLER. The mechanism of reduction of chromic acid to the trivalent state and the influence of sulphate upon it is discussed by the author. The bisulphate ion can if drawn in fact enough effect a solution of the film which at moderate current densities inhibits reduction. The curves for carbon cathodes are analyzed and their form is related to the uneven current distribution over them.

16. **"The Structure and Properties of Nickel Deposited at High Current Densities"**, by W. BLUM and C. KASPER. Electrodeposition of strong $NiSO_4$ and $NiCl_2$ solutions was investigated at high current densities (100 to 2,000 amps/ft^2). Quantitative results are given around 300 amps/ft^2. The solutions are very acid (pH of 1) and temperature around 100° C. No pitting is observed, and neither is it necessary to purify the solutions. The nickel chloride bath gave rise to hard deposits, while the nickel sulphate solution gave soft, ductile deposits.

17. **"Electrode Potentials and the Form of Electrodeposited Metals"** by SAMUEL GLASSTONE. A critical analysis of existing data indicates that no connection exists between the cathode polarization and the type of electrolytic deposit. The polarization in the silver cyanide bath is almost entirely concentration polarization. The author believes that the deposition of silver from the silver cyanide bath occurs from a positive ion Ag_2CN^+.

18. **"Contribution to the Experimental Study of the Influence of the Support or Cathode on the Structure of Electrolytic Deposits Obtained in Aqueous Solution"**, by ALBERT M. PORTEVIN and MICKEL CYMBOLISTE. The continuation of the crystal structure of a cathode is determined not only by the crystal structure of the support itself, but also by the solution and condition of deposition. In general low rates are favorable for a continuation.

18a. **"Factors Affecting the Structure and Grain Size of Electrodeposited Cadmium"**, by S. WERNICK, M.Sc. *Cyanide Solution.* On varying the cadmium content from 8 to 40 g/liter there was an improvement in the deposits. Deposits became finer-grained with increase in cadmium content. The effect of "free" cyanide was even more marked. With increase in free cyanide the deposits became white. Range studied (25-150 percent free cyanide) equivalent to 17-102 gm/liter of potassium cyanide. Advisable to limit free cyanide to 100 percent, as at higher values the efficiency drops. A small amount of caustic soda was beneficial. The current density had a marked effect on the quality of the deposit. With a solution composition of 30 g/liter of cadmium, 100 percent "free" cyanide and 1.5 percent caustic soda, the optimum current density was 10-15 amp/ft^2. 30-35° C is advised as the best operating temperature. *Cadmium Sulphate.* Deposits are quite crystalline. Varying the pH from 3.6 to 5.3 resulted in a finer-grained deposit. Increase of current density from 10 to 85 amp/ft^2 resulted in an improvement of the deposit. The temperature range from 22° C to 80° C was investigated. Up to 50° C the deposits became darker and finer-grained. Above 50° C the deposit became whiter and more crystalline. The addition of dextrin, peptone, and gelatin were studied. Dextrin and peptone gave rise to dark fine-grained deposits. Gelatin, on the other hand, gave rise to fine-grained white deposits.

19. **"Influence of the Basis Metal on the Structure of Electrodeposits"**, by A. W. HOTHERSALL. A study of continuation of the structure of the basis metal by coarse grained copper, nickel and tin electrodeposits. The degree of continuance varies from base metal to base metal. The article is profusely illustrated with examples. No definite conclusions are drawn, but it is possible that continuance of structure is related to the adherence.

20. **"Differences in the Structure of Electrodeposited Metallic Coatings Shown by X-ray Examination"**, by W. A. WOOD. A study of electrodeposits by means of X-rays. It is possible by means of a critical study of the sharpness of the X-ray diffraction pattern to assign value to the sizes of the crystals in deposit. Hard deposits generally give rise to sharper diffraction patterns, which are indicative of a very fine grain. Chromium deposits from the chromic acid bath have a grain size about three ten-millionths of an inch.

22. **"Determination of the Phase Structure of Metallic Protective Coatings by Anodic Dissolution"**, by A. GLAZUNOV. In cases where the basis metal is protected by a more active metal it is possible to determine its thickness by studying the voltage current characteristic of a cell, in which the coating is the anode.

23. **"Improvement of the Quality of Metallic Coatings by the Use of Non-Metallic Intermediaries and Supports"**, by H. REININGER. The galvanized and sprayed metal coatings have a very poor adherence and are liable to peeling and cracking. This is particularly true with coarse-grained deposits. By varnishing the coats with a linseed oil-copal varnish improved resistance toward mechanical flaking was obtained. The results were obtained with sprayed nickel on hard brass.

24. **"Factors Influencing the Formation and Structure of Hot-Dipped Tin Coatings"**, by EDWARD J. DANIELS, M.Sc. Existing theories of the factors involved in the formation of hot-dipped coatings are reviewed and attention is directed to the attraction between the liquid and solid metals as the prime cause of wetting. In general, affinity between base and coating metal results in the formation of an inter-metallic compound or solid solution. Additions to the molten metal sometimes lead to considerable alterations in the structure of the coating. A discussion is given of the theory of fluxes for producing hot-dipped coatings.

Electrodeposition of Platinum on Silver, Nickel or Copper. *Deutsche Goldschmiede Zeitung.* Vol. 38, No. 13, page 133, 1935.—Formerly the electrodeposition of platinum was accomplished from solutions of platinum hydroxide in potassium hydroxide. These baths contained, in general, about 4% free alkali hydroxide, were run at temperatures below 95 degrees F with a potential of 2 volts. Excellent bright deposits were obtained for a short time on silver, nickel or copper and then the bath became turbid with the formation of a precipitate of hexaoxyplatinic acid on the anode. The platinum deposit became dull, spotty and possessed little adhesion. A new process is proposed which contains the alkaline platinate as a conducting salt, a compound to prevent the hydrolysis of the platinate as well as free alkali less than 2.5%. It is operated over 105 degrees F., does not plate by immersion of the cathode and gives a smooth, white, adherent plate. A typical bath is prepared as follows: 4 lbs. 6 oz. of sodium chloroplatinate are dissolved in 8 gal. of hot water and 4 lbs. 6 oz. of caustic soda are added. When the caustic is all added dilute to 15 gal. with hot water and continue the boiling for 3 to 4 hrs. until the color of the solution changes from orange to pale yellow. Cool the solution and add 1 lb. of oxalic acid and 2 lbs. of con. sulfuric acid which has been diluted with water. Dilute to 30 gallons. The solution contains about 1% platinum and .5% free sodium chloride and sodium sulfate for conductance. Operate between 150° F-180° F at 20 amps. per square foot.

WALTER R. MEYER

Brass Electro-deposits as Intermediary Coatings. By A. BRAUN. *Oberflächentechnik*, Vol. 12, 4, page 39-42, 1935.—The use of brass as an undercoat previous to nickel plating has been unjustly neglected as it possesses many advantages over copper. Brass gives better corrosion resistance to steel than copper, plates smoother at higher current densities and other metals have better throwing power on brass than on copper. Additions of brighteners as ammonia, arsenic and phenol permit 30-40 min. bright plating with brass but not so with copper. Systematic comparisons were made between brass and copper deposits on iron, aluminum, zinc and tin basis metals. Better coverages and adhesion were obtained for nickel over brass than over copper, both for rolled steel and cast iron. Excellent adhesion of brass-nickel deposits on aluminum was obtained by cleaning in a solvent, etching in a zincate etch, brass plating for 20 min. and then nickel plating. Zinc base die castings were brass and then nickel plated and proved to give more adherent deposits, less corrosion spots and less blisters than copper-nickel coatings of the same thicknesses. (Experiments by this abstractor have shown, however, that from a diffusion standpoint copper is superior to

brass whenever the ambient temperature approaches 100 degrees C. With current densities ranging from 2 amps. per square foot to 8 amps. the cathode efficiency of brass was from 10 to 20 per cent higher than that of copper. (These values may vary widely with variation in free cyanide content—WM). In a study of brighteners, phenol (carbolic acid) proved to be an effective brightener at concentrations from .02 oz/gal. to .07 oz/gal. Sodium phenol sulfonic acid and sodium meta cresolsulfonic acid were equally effective. Arsenic was effective, ammonia only fair, while detrin, Turkey Red Oil, caramel, and malt extract were poor. W. R. MEYER

Influence of Iron on Chromium Hardness. By R. J. PIERSOL. *Metal Cleaning and Finishing*, Nov., 1934, p. 557.—Using an abrasion test on deposits from a bath containing 250 g/l. chromic acid, 2.5 g/l. sulphate, 1 g/l. trivalent chromium, increases in iron content of the bath up to 18 g/l. Fe. are shown to increase progressively the obtainable hardness and also the bath resistivity. 10 g/l. Fe. is the concentration recommended under the conditions given. Curves are given to show the change of hardness with rate of deposition at various iron concentrations. However, other means of obtaining hard deposits, such as regulation of the trivalent chromium concentration, are preferred. C. T. THOMAS

The Exfoliation of Nickel-Chromium Deposits. By ANDRE DARLAY. *Galvano*, May 1934, p. 17.—Various causes for the lifting of nickel deposits are sometimes discussed at length. Actually ninety per cent of these cases are due to faulty removal of grease and oil films, as can be shown by trial pieces. In the case of electrolytic cleaners, the bath soon becomes dirty, and, unless changed frequently, will leave films on the supposedly clean surface of the work. In the case of the degreasing-coppering bath, in which a preliminary coating of cyanide copper is deposited in the cleaning bath itself, lifting of the nickel deposit may occur if the constituents of the cleaning bath are not in the proper proportion, if anodes other than copper are used, if the bath contains impurities or if it is not properly operated. The author strongly recommends this latter process in preference to the straight electrolytic cleaner. Even where trial pieces show that the cleaner is not the source of trouble, the course may yet be located in the handling of the work from the cleaner to the plating bath. Finally, in some cases, the trouble may be in the plating bath itself. If the bath has been operating well previously, the cause may be excess acid or alkali, excessive of some impurity, too high a current density, an interruption in the current, or the presence of organic matter. (The American practice of using an acid treatment, as an acid dip, between the alkaline cleaner and the plating tank to secure better adherence is apparently not followed in France.—C.T.T.)

C. T. THOMAS

Cadmium Electro-deposits to be Buffed. F. SCHWARZ. *Oberflächentechnik*, Vol. 12, **7**, page 82, 1935.—Cadmium deposits are usually so soft that it is difficult to buff them even with Vienna lime, without cutting through. A relatively simple means of hardening the plate is to add a small quantity of zinc to the solution which will be deposited with the cadmium as an alloy. The zinc deposits less readily than the cadmium which requires a 10:1 ratio of Cd to Zn before a noticeable zinc deposition is obtained. An

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alloy of 85% Cadmium 15% zinc is hard, has good rust resistance and has the external appearance of pure cadmium. It is deposited from a bath containing equal quantities of zinc and cadmium at current densities of 20 to 40 amperes per square foot. The following buffing compound is recommended: 12 parts Vienna lime, 2 parts tallow, 2 parts stearin, 1 part Montan wax, 1 part mineral oil. It forms a dry paste and is used on a soft flannel wheel.

WALTER R. MEYER

Mechanical treatment of electro-deposited coatings. Anon. *Engineering* (London) **139**, 101 (1935); Jan 25.—The success attainable in milling, turning or grinding engineering parts built up by electrodeposition is dependent on the adherence of the plate to the base metal. Nickel, chromium and iron are most used, and for research work the expensive platinum-iridium and platinum-rhodium deposits on instrument points have shown good wear resistant qualities. The plating on parts of different shape should be of uniform hardness for uniform machining; the tool is best introduced away from the edge to prevent tearing. Nickel, chromium and iron deposits can all be machined dry, but lubrication can be used to preserve the cutting edge of the tool. Tantalum-carbide and tungsten tipped turning tools have probably met with most success for chromium and nickel deposits, respectively. A clearance angle slightly different from that employed for ordinary turning should be used. High cutting speeds have not been successful and the conditions of speed, etc., to use are determined for the metal deposited. Grinding is generally superior for finishing built-up parts however certain iron deposits can be carburized and converted to any desired hardness to suit the cutting tools. If the deposit shears off on turning it can be photographed (full size) and the image thrown on a screen without excessive magnification to detect any sign of cleavage at the junction of the deposit and the base metal. If none, the defect may be ascribed to imperfect machining. Cleavage of the deposit is infrequent and can be remedied in the plating room. Microscopic studies have not proved useful, and X-ray examination also fails to give the exact position of the defect. (Abst. note: Wet grinding of chromium is superior to dry.)

R. M. WICK

Lanolin Rust Preventers. By C. JAKEMAN. *Engineering Research Special Report No.* 12, Department of Scientific and Industrial Research, London, 26 pages, Second Edition, 1934, Os. 6d.—Tests supervised by the national Physical Laboratory, extending over five years to find the best means of protecting against rust the bright steel parts of stored machinery are described. The most satisfactory and economical method found was to coat the metal parts with partially refined lanolin (wool grease product and a waste product of the wool-combing industry). Pure lanolin is too expensive. The method recommended is to dissolve the lanolin in white spirit or solvent naptha. 7.8 lb. of lanolin to one gallon of white spirit or 8.3 lb/gal of solvent naptha. This quantity applied to the metal with a soft brush will cover about 1200 ft. of surface. The efficiency of these mixtures, and the suitability of the solvents from the point of view of initial cost and safety in use, were demonstrated by laboratory experiments and by tests on sea-going vessels passing through the tropics. Results of laboratory work have been confirmed by treated metals stored over a period of five years. Under ordinary

storage conditions the recommended coatings give sufficient protection against rusting over a period of five years, even when the coated pieces are frequently handled. During storage in a severe corrosive atmosphere, such as in an ammonuim nitrate shed, satisfactory protection is given for three years, the probable loss being less than 3% if the pieces are not handled during storage. *M. A.*, 4, p. **157**, 1935, V. V. K.

Formation of Bright-Nickel Electrodeposits in the Presence of Colloids. *Die Metallwaren-Industrie und Galvano-Technik.* Vol. 33, No. 5, page 97, 1935—Bright nickel deposits can be made from baths containing organic or inorganic colloids. The brightness of plate varies with the current density and the brilliant zones are those in which the pH is just lower than that at which a visible precipitate of nickel hydroxide or basic salts are produced. These basic salts are in the colloidal state and increase the hardness and brilliance of the deposit by co-deposition with the nickel. A photo-electric cell can be used to compare brilliance by measuring the reflectivity of a standard beam of light. The brilliance drops from a maximum for a pH of 6.7 to a minimum at 5 and then increases again with lower pH. Sodium sulfate brightens the nickel by increasing the formation of flocculent basic nickel salts. Cadmium forms colloidal basic salts near the cathode which are co-deposited with the nickel. Gelatine in concentrations as little as 2.5 milligram per liter (.0003 oz/gal.) is an effective brightener as is protein (Eiweiss). W. R. MEYER

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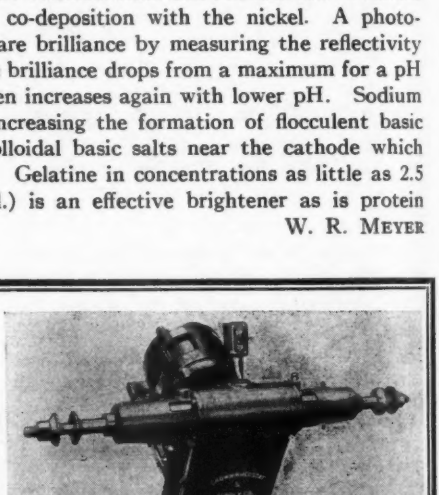

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Benefits of Membership *in the A. E. S.*

President Gilbertson's Address to Milwaukee Branch

OFFICERS, members of the Milwaukee Branch and guests: When your chairman, Mr. Dan Wittig, asked me to say something about the benefits of membership in the American Electro-Platers' Society, I felt that he could not have chosen a better topic, nor one more appropriate at this time when all our Branches are in a drive for new members.

It is an easy thing to sell something which you are sold on yourself. I want to tell you that I was sold on the A.E.S. twenty-one or twenty-two years ago when I joined. First, because the society was formed for the improvement of the art of electrodeposition and the dissemination of the knowledge of its practice and second because electro-plating was my chosen art which I have also made my hobby.

Previous to being a member of the A.E.S., I had been a member of the American Chemical Society and the American Electro-Chemical Society. While both these societies were and are of the highest standing and their work equally important, I personally felt that our A.E.S. specializing on that part of electro-chemistry which is directly concerned with our particular art, was the organization which would do me the most good. While these other societies were of great value in keeping one informed on chemical and electro-chemical developments, they very seldom helped the electro-plater in developong or improving his practise. I feel that the American Electro-Platers' Society has filled a field which no other society could. I know there are many who feel the same way.

To quote Dr. Wm. Blum: (First Educational Session 1934 Convention) "I feel that this organization is practically the only channel through which the electro-plating industry can be reached because of the fact that electro-plating is applied in so very many industries that organizations of these industries are not particularly suitable to take up problems of plating; so we depend upon you, the electro-platers' society, to try to apply, to correct, or to criticise any of the results that we obtain in our research work at the Bureau of Standards."

I believe that this is an acknowledgement that the American Electro-Platers' Society is the society, which specializing as it does on electro-deposition, is accomplishing its objectives and that it is recognized nationally, if not internationally, as the outstanding organization of its kind.

Time will not permit a lengthy review of the work of this society or its accomplishments, but it may be appropriate to mention some of the important factors which have made the A.E.S. what it is today. First, I believe that one of the most important reasons why the society has progressed, is because its members have been loyal to its purpose. They have willingly and cheerfully carried on its work. We have present tonight some of the earlier officers of the society. Mr. George B. Hogaboom who was its first Supreme President. Mr. Oscar Servis, one of the first Supreme Secretaries who later became a Supreme President. Mr. Robert Steurnagle another Supreme Secretary and Mr. Frank Hanlon who served the A.E.S. for nine years; first as Supreme Secretary, then as Supreme President and then as Editor. These men have not lost interest after going out of office, but are today just as interested in the society as they ever were. I believe that the organization is indebted to such members as these and many others who like Mr. Wm. Phillips willingly give of their time and experience to our cause, so that the science of electro-plating can be developed. These men have the determination to see that this organization shall progress; shall keep to its ideals, shall continue to advance along the lines set out by our constitution. As I have said this type of member is the one most important factor of the success of the American Electro-Platers' Society.

Second in importance I believe is the policy of not keeping the same officers for too long. To be a Supreme Officer, aside from being a personal sacrifice, is also a well worth experience which will make one appreciate what others have sacrificed to make this organization possible. It gives one a broader view of our extensive work and its responsibilities. I say that the more past officers we have the better for the A.E.S.

Another factor in the success of our organization is the policy of strictly adhering to the purposes of the society, that of educating its members in electro-plating and nothing else.

The object of our membership drive is not for the purpose of making money for the society, but for the purpose of enlarging our membership with men who will carry on the work of the society in the objectives set out in our constitution, the advancement of electro-plating knowledge.

I will endeavor to point out some of the advantages of being a member of the A.E.S. You have the advantage of association and direct contact with the foremost men in your field. You get the most up-to-date information on all electro-metalurgical subjects through our MONTHLY REVIEW. You get information regarding the health and hazards of the industry. You have the advantage of attending our annual meeting when all the developments of the past year are reviewed before our convention. You have the satisfaction of being influential in taking part in the electro-chemical development of our country.

How can any one of you afford to not be a member of such an organization? I want to say for your own good, join the A.E.S. and become one of its boosters.

Before this organization was formed a certain electro-plater working for the Rockford Silver Company found himself in the following predicament: He had been plating hollowware for years and was considered a very good plater, but when he was called upon to plate steel knives, he failed. The firm had allowed him to experiment, but to no avail. He just could not make the silver adhere to the knives. The company offered him a last chance by ordering a gross of knives from every flatware manufacturer in the country. They made the plater a proposition, that if he could plate any one dozen of any one gross of these knives without failure the company would continue to experiment. On the other hand, if he failed they would get another plater. He failed. The firm secured another man who after changing the dips a little proceeded to plate the knives in the same solutions without any failures. The first plater was so disgusted that he committed suicide. This is only one instance where an isolated plater could have been helped out of his trouble by being a member of the A.E.S.

Some years ago a certain nationally known flatware manufacturer started to make a hollow ware line. The tea and coffee

pots were not properly plated on the inside. The firm had reject after reject until they finally dropped the manufacturing of hollow ware. A member of the A.E.S. gave this company's plater the cause of his trouble so that he could have corrected it, but it was too late. The firm had definitely decided to discontinue the manufacture of hollowware. There are many cases such as these which membership in our organization has corrected. I want to say to every one who is engaged in electro-plating and who is eligible to membership, join the American Electro-Platers' Society for it is worth while.

A Message from
Mr. G. B. HOGABOOM
to all branches of the A. E. S.

There will be more than fifty exhibits at the A.E.S. 1935 Convention at Bridgeport, Connecticut. The success of this first exhibition depends entirely upon the support given by the members of the A.E.S. If this exhibition fails or there is not sufficient interest shown it will be impossible to offer any inducement to manufacturers to exhibit again.

There is one way that will show that the A.E.S. is vitally interested in this exhibition and that is for each Branch to send an exhibit of any electroplating process or finish that the members are producing.

Your Branch should appoint a representative committee of alert members and assign them the task of making up an exhibit. The Supreme Society has reserved special space for Branch Societies Exhibits.

You have sufficient time if you get busy right away. Let the Society see what Branch is most skilled in electroplating or the finishing of metals. Surely the members of your Branch produce better work than that of any other Branch — Prove It.

I expect a letter by return mail giving the names of the Exhibition Committee. Don't wait for the next meeting. Get in touch with the President and have him call a meeting of the Executive Committee.

Yours for a successful exhibition,

GEORGE B. HOGABOOM,
Chairman, Branch Society's Exhibits Committee
557 Stanley Street,
New Britain, Conn.

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An economical, dependable method for rust protection.

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Principles of Chemistry

For ELECTROPLATERS

DR. WILLIAM BLUM

LESSON V

1—Kinds of Chemical Compounds:

(a) The simplest compounds are *binary*, that is they contain only two elements, of which one is generally a metal (or chemically metallic) and the other is a non-metal.

(b) The *names* of such compounds usually end in *ide*, attached to the name of the non-metallic element. Thus zinc oxide (ZnO) is a compound of zinc and oxygen. Examples of binary compounds are iron sulphide, FeS; sodium chloride, NaCl; and water, H_2O (which might be called "hydrogen oxide").

2—Valence:

(a) The proportions in which elements combine, as stated in the formulas of the compounds, depend on the respective *valences* of the elements. The valence of an atom of an element (when combined) is equal to the number of atoms of hydrogen which it will combine with or replace. The valence of a hydrogen atom is defined as *one*. In water, H_2O, one atom of oxygen combines with two atoms of hydrogen, hence the valence of oxygen is *two*. The valence of hydrogen and of metals is positive (plus); that of oxygen and non-metals is negative (minus). Hence the valence of hydrogen is +I, and of oxygen is —II. Water is "neutral", as are other compounds, that is, the sum of the positive valences is equal to the sum of the negative valences. These valences only apply to the elements when they are combined. When free, the valence of each element is *zero*.

A table of valences of elements is given in Blum and Hogaboom First ed., p. 341, or 2d ed., p. 404.

(b) Calculation of the *formula* of a compound from the valences. What is the formula of hydrogen chloride (hydrochloric acid)? The valence of hydrogen is +I and of chlorine (in chlorides) is —I. Hence the formula is HCl. What is the formula of calcium oxide (lime)? The valence of calcium if +II and of oxygen is —II. Hence the formula is CaO. What is

the formula of aluminum chloride? The valence of aluminum is +III and of chlorine is —I. Hence aluminum chloride is $AlCl_3$. What is the formula of aluminum oxide? As the valence of aluminum is +III and of oxygen is —II, two atoms of aluminum are equal to three of oxygen, hence the formula is Al_2O_3.

(c) Some elements have more than one valence. Iron in *errous* compounds has a valence of +II, and in ferric compounds a valence of +III. Copper in *cuprous* compounds (as in cyanide copper baths) has a valence of +II and in cupric compounds (as in acid copper baths) a valance of +II. The formulas of the corresponding oxides are therefore:

Ferrous oxide, FeO
Ferric oxide, Fe_2O_3
Cuprous oxide, Cu_2O
Cupric oxide, CuO

(d) Oxidation and reduction. Whenever in a chemical reaction the positive valence of an element is increased (or the negative valence decreased), *oxidation* takes place; and whenever the reverse occurs, *reduction* takes place. Thus if a ferrous salt (Fe^{+II}) is changed to a ferric salt (Fe^{+III}), the ferrous salt is *oxidized*. If, however, a curpic salt (Cu^{+II}) is changed to a cuprous salt (Cu^{+I}) the cupric salt is *reduced*. Whenever a metal goes into solution at an anode its valence is increased from *zero* to its value in the salt, for example silver from Ag° to Ag^{+I}. An anodic process is always *oxidation*; and a cathodic process is always *reduction*, for example from Ag^{+I} to Ag°.

3—Electrolytic Dissociation:

(a) Aqueous solutions of acids, bases and salts conduct electricity, but solutions of other compounds such as sugar, alcohol and glycerine, do not.

(b) When acids, bases or salts are dissolved in water, they are decomposed or dissociated, in part at least, into electrically charged particles, called ions. Thus when hydrochloric acid HCl, is dissolved in water, it forms hydrogen ions, H^+, and chloride ions, Cl^-.

$$HCl \leftrightarrows H^+ + Cl^-$$

Similarly sodium chloride, NaCl, forms

$$NaCl \leftrightarrows Na^+ + Cl^-$$

Copper (cupric) sulphate, $CuSO_4$, forms

$$CuSO_4 \leftrightharpoons Cu^{++} + SO_4^{--}$$

The number of positive or negative charges on an ion is equal to the valence of that ion.

(c) When a current is passed through such a solution, the positively charged ions (cations) move toward the cathode (the negatively charged electrode) and are discharged or deposited there, and the negatively charged ions (anions) move toward the anode, and are discharged there (or else combine with the anode to form salts). For example when a current is passed through a copper sulphate solution between copper electrodes, the cupric ions (Cu^{++}) pass to the cathode and are there reduced to copper; and the sulphate ions, (SO_4^{--}) pass to the anode, where they combine with the copper of the anode to form copper sulphate.

Problems

1—Insert in the following table the formulas of various compounds:

Metal	Symbol	Valence	Oxide	Chloride	Sulphide
Lead	Pb	+II			
Silver	Ag	+I			
Tin	Sn	+IV			
Arsenic	As	+V			
Anti-mony	Ab	+III			

2—If copper carbonate, $CuCO_3$ is dissolved in sodium cyanide, the copper is reduced from Cu^{+II} to Cu^{+I}, with a corresponding decomposition of NaCN, as follows:

$$CuCO_3 + 4NaCN = Na_2Cu(CN)_3 + Na_2CO_3 + CN$$

If the same solution is prepared from cuprous cyanide, the equation is:

$$CuCN + 2NaCN = Na_2Cu(CN)_3$$

Suppose 100 gallons of a solution was to be made, to contain 3 oz/gal of metallic copper, what would each method of preparation cost with the following prices:

Copper cyanide, 39 cents per lb—
Copper carbonate, 15 cents per lb.—
Sodium cyanide, 18 cents per lb.—

NEWARK BRANCH

The Newark Branch held its regular meeting in April and Mr. A. J. Sizelove spoke on a new color gold solution. Mr. D. X. Clarin and Mr. E. Ward of the Oakite Products Co. exhibited 6 reels of moving pictures for the meeting April 6th and a fine attendance was had. The Newark Branch's All Day Session preparations are all made for a wonderful time.

Mr. Nelson Sievering, the librarian of Newark Branch has arranged a very fine program and all members of the Society are urged to attend.

GEORGE REUTER, *Secy.-Treas.*

WATERBURY BRANCH

The April meeting of Waterbury Branch was held Friday the 12th, and although the weather was not too inviting, a good attendance was present to hear Mr. A. A. Klein, research engineer of the Norton Co., Worcester, Mass., give an interesting talk on "The Properties of Manufactured Abrasives used for Polishing." The speaker's talk was devoted mostly to the aluminum grain, and what was being done to further the interests of the metal polishing industries. A description of the make-up of wheels was given. The sizing glue and abrasive trough; the drying, temperature and humidity were approximately given. The glazing of wheels and the sizing and screening of grains were touched on. The speaker's remarks were illustrated. At the conclusion, interesting discussions took place, bringing out the experiences of polishers at the business from 35 to 43 years. A rising vote of thanks was given Mr. Klein

Communication from the Newark Branch, relative to their banquet, April 27th, was read and all who were looking for a good time, advised to go. Communication was received from the New York Branch, relative to a resolution passed at their meeting March 22, 1935. After much discussion on the subject, it was decided that in order to give all members of the Branch a chance to vote on the matter, return ballots be sent out, with instructions to return same at the next meeting, May 10th. Communication from the International Nickel Co., Inc., relative to Research Paper RP-712 was read and appreciation expressed for the offer.

WM. F. GUILFOILE, *Secy.*

BRIDGEPORT BRANCH

By the large attendance at our April meeting, members of the Bridgeport Branch were truly convinced that fellow members were interested in the coming Convention.

The Roll Call of Officers and the minutes of the last meeting were read and accepted. Tom Chamberlain, Secretary of the Convention, read a report concerning the preparations being made for the Convention to be held in Bridgeport in June.

The Elections of Officers took place and the following were elected to serve during the coming year:

President, Joseph Sexton; Vice-President, Joseph Sterling; Sec'y-Treas. Charles Costello; Librarian, Walter Meyer; and Sargent-at-Arms, William Stratton.

Board of Managers—John Oberander, William Thompson, and Ben Kusterer. Delegates and Alternates to the Convention, Raymond O'Con-

nor, Joseph Sexton, Joseph Downs, and Walter Meyer, William Bridgett, and Al Rosenthal.

Previously, plans had been made to have this meeting an Open Meeting, but due to the election, the Open Meeting will be held on Friday evening April 12 and Walter Meyer will be the guest speaker. All bills against the Branch were ordered signed and paid. Treasurer's report was read and accepted. The meeting adjourned at 11:00 P.M.

The Bridgeport Branch held their last Open Meeting of the season on Fr day, April 12, at the Stratfield Hotel. George Wagstaff, Chairman of the Program Committee introduced Walter Meyer as the speaker of the evening. Mr. Meyer gave a very interesting talk on "The Finishing of Zinc Base Die Casting." Mr. Meyer is a graduate of Yale University, he has been associated with the Sargent Co., as Chemist, and at present he is employed at the General Electric Co. in Bridgeport. He too, is the author of numerous articles published in the Metal Industry, the MONTHLY REVIEW, and the Metal Cleaning and Finishing.

During the course of his lecture, Mr. Meyer explained slides, showing the operation of Plating Solution. He was thorough in bringing to light the methods of plating and finishing, types of deposits, and information on Brass and Copper.

This and other interesting lectures will be given by Mr. Meyer again in June, at the Convention to be held in Bridgeport.

At the Conclusion of his talk Mr. Meyer answered many questions put to him by members in attendance.

Ray O'Connor, Chairman of the Convention read numerous subjects that will be brought to the attention of members by speakers at the Convention in June. All plans are near completion and it is expected to be a most successful affair with the cooperation of all members of all Branches. WM. FLAHERTY, *Secy.*

MILWAUKEE BRANCH

The regular meeting of Milwaukee Branch A.E.S. was held Thursday evening, April 11, 1935 at Lipp's Hall, N. 3rd and W. Highland Ave. The meeting was called to order by President Pat Sheehan. A large attendance was present.

The Educational Meeting and Smoker held by Milwaukee Branch on Saturday, March 30th was the most successful meeting of its kind held by our Branch, the attendance of over 200 was way above the crowd we had expected. Originally planned to take place in the Green Room, but had to be transferred to the Grand Ball Room, as the reservations by Saturday morning convinced the committee that the Green Room would not hold the crowd that we expected. We had delegations from all the principal cities of Wisconsin, also some from Northern Michigan, Minnesota and Illinois. The program was as originally announced: Geo. Hogaboom, "What is under the plate," Supreme President H. A. Gilbertson, "Benefits of membership in the A.E.S.", W. H. Phillips. "What really takes place in a plating bath?" The speakers were all well received, as the topics had not been shown in Wisconsin, and there were many bursts of applause for each speaker. When the educational program was finished the crowd made a grand rush for the fine buffet lunch and refreshments. After filling the inner man the crowd was again reassembled for a fine A-1 *none better ever shown anywhere* floor show that

kept our visitors in good humor, with plenty of the stuff that made Milwaukee famous was on hand to keep the crowd till the wee hours.

FRANK J. MARX

ST. LOUIS BRANCH

Regular meeting of St. Louis Branch was called to order by President Vogt. Regular order was suspended and each man was asked to make a few remarks. Mr Beshey from Wichita, Kansas, a member of St. Louis, was present, and had some fine samples of the work he was doing. We also had Mr. Paul Miller of Evansville, Indiana, present, and our President had some samples that looked fine. We also had about five visitors.

All in all it was a real meeting, so we are going to have the same kind next month. Hope they all turn out April 12, 1935, same place and time.

CHAS. T. MCGINLEY, *Sec.*

CLEVELAND BRANCH

The regular monthly meeting of the American Electro-Platers' Society was held at Hotel Carter, Saturday, April 6th, 1935. The meeting was called to order by our president, Mr. W. D. Scott, at 8:15 p.m. The minutes of the March 2nd meeting were approved of as read.

The application for associate membership of Mr. Hull of the Grasselli Chemical was voted on, and he was elected, glad to have a man of his type in our society.

A letter from our supreme president was read, which was to allow assistant foreman platers into our society as associate members when they had 5 years plating experience, one year of which was as an assistant foreman. After some discussion Mr. Matts made a motion that our delegates be instructed to vote against this proposal, which was seconded by Mr. Ter Doest. The vote was carried.

Our librarian, Mr. Thompson, then read a paper on "Intermittent test as an Aid in Determining Life of Zinc on Iron and Steel". It was a very fine paper and quite a few interesting points were brought out. After some discussion a motion was made to adjourn. W. E. O'BERG, *Sec.-Treas*

DETROIT BRANCH

A regular meeting of the American Electro - Plater's Society, Detroit Branch, was held in Hotel Statler, Friday evening, April 5th, at 8:00 P.M., with a very good attendance, Col. J. H. Hansjosten presiding. The minutes of the previous meeting were read and approved.

The following applications for membership were read and referred to the Board of Managers.

James W. Overton,
921 E. Paterson St., Flint, Mich.
Harry C. Crook,
1123 Saginaw St. S., Flint Mich.
R. G. John,
2121 Hibbard Ave., Detroit, Mich.
Robt. J. Green,
Golde Patent Co., Ypsilanti, Mich
Frank Lester,
2125 Harger Ave., Dearborn, Mich.
Wm. H. Ross,
1651 E. Grand Blvd., Detroit Mich.
Sol Burg,
3794 Humphrey, Detroit, Mich.
Frank Watt,
3rd and Larned Sts., Detroit, Mich.

The following applications were reported on by the Board of Managers as eligible for election to membership. They were unanimously elected.

Raymond J. Simsick,
7028 Holmes Ave., Detroit, Mich.
Frank Gach,
6628 Willette, Detroit, Mich.
Roy Rapp,
R. F. D. No. 1, Wyandott, Mich.
George A. Lodge,
2100 Hubbard St., Detroit, Mich.

Russell Raab
3204 Helen Ave., Detroit, Mich.
Reinstated:
Hyman Weimar (Active),
648 Mt. Vernon Ave., Detroit, Mich.

The meeting then proceeded to the nomination of officers for the ensuing year.

W. W. McCord was nominated for President. Arthur Gordon Spencer was nominated for Vice-President. T. C. Eichstaedt was nominated for Secretary-Treasurer.

Nominations for Board of Managers, three to be elected: George Kutzen, Charles Beaubien, A. B. Wilson, T. Kirby, L. P. Brockway, Geo. L. Nankervis.

Nomination for Librarian: Chester Marshall.

Nominations for Delegates to the Convention: T. C. Eichstaedt, L. P. Brockway, R. J. Lattimer, Geo. Kutzen, M. B. Harris, Archie Burrows, A. B. Wilson. Three of these nominees are to be elected as Delegates, and three as Alternates.

Mr. Hyman Weimar, 648 Mt. Vernon Avenue, was reinstated to active membership.

Mr. B. F. Lewis was then introduced as the Speaker of the evening. The topic of his talk, as he had no paper, was "The Advances in Modern Electro-Plating." Mr. Lewis covered this subject very efficiently in general, starting off with a sort of history of the electro-plating as has been, and then went into the advances which are, as follows: The efficient solutions, methods, and processes of electro-plating zinc base die castings. He also went very deeply into the semi-bright, low cyanide content copper baths, touching on the improved tin baths, finally going into the chromium plating. He gave as the basic principles in electro-plating the efficient cleaning method as one of the most important parts of the electro-plating process. Next to that he gave the modern chemical control of all plating baths as being one of the greatest and most important advances in the electro-plating industry. Mr. Lewis, a member of the Detroit Branch, and known to every member of the Society, known not only locally but nationally, showed that he understood what he was talking about. I am very sorry he did not have this in the form of a paper so that it could be sent on for publication, but trust that in the near future he will put it in writing, and if so, I will forward it to the REVIEW so that the platers of the country can have the benefit of it.

The meeting adjourned at 9:30 P.M., but before the adjournment, the Committee which was appointed at the previous meeting to furnish refreshments and entertainment for this meeting, stated that immediately upon adjournment of the meeting the refreshments would be served. Tables were set in the room and those present seated themselves around these tables and proceeded to dispose of the refreshments amid much chatter, while the entertainment part of the evening was taken care of by three musicians, piano, violin, and guitar. The gentleman playing the guitar also sang, which greatly enlivened the party, as he sang songs which were familiar, and everybody joined in the chorus. We had a very good time. Everyone enjoyed themselves and it was expressed during the evening that we have more of this kind of meeting in the near future

T. C. EICHSTAEDT, *Sec.-Treas.*

LOS ANGELES BRANCH

Minutes of the regular monthly meeting of the Los Angeles Branch American Electro-Plater's Society held March 13th, 1935, at the Rosslyn

Hotel. Eleven members and one visitor were present. President M. D. Rynkofs presided.

The secretary was instructed to have the books in shape to receive the annual audit of the Board of Managers. Ralph Wilde was appointed to act on the board with Ed. Williams and Ted Delaney.

The secretary was also instructed to mail the meeting notices out on Friday before the meeting instead of Monday.

The meeting was turned over to the librarian who found the following questions in the box:

Q. What is the best speed for polishing and buffing?

A. When the same lathe is used for both operations the best speed is 2200 to 2500 R.P.M.

Q. What makes a chromium solution plate bright?

A. If the solution is properly balanced and run at the proper temperature and current density it will plate bright. EARL COFFIN

CHICAGO BRANCH

The regular monthly meeting of Chicago Branch was held Saturday, April 13, 1935, at the Atlantic Hotel. President E. G. Stenberg presided and all other officers were present.

A new application was received from J. A. Henricks and a committee appointed on same. Mr. H. A. Haisman was elected an active member. A letter received from the New York Branch was read and placed on file.

Mr. C. Kocour demonstrated a drop test instrument for testing cadmium and zinc which proved very interesting.

Here Mr. J. F. Calef gave a very interesting and instructive talk on zinc plating solutions and the testing of some of the deposits. Mr. Calef answered the many questions asked by the members present. This paper was so well presented by Mr. Calef that it is hoped that the same will be published in the REVIEW in the near future.

Mr. O. E. Servis the librarian found the following questions in the question box.

No. 1. Should a cleaner be thrown away every three or four days and a new one made? I was told that this practice will make nickel plated steel parts come out of the nickel tank much brighter.

Answer. Depends on the size of the cleaner solution and the amount of work, being passed through the cleaner solution each day.

No. 2. What is the best nickel plating bath to use for barrel nickel plating at 6 volts and at room temperature? Also will the deposit be bright?

Answer. Depends on the type of work you want to do. There are many good brighteners for nickel solutions on the market.

No. 3. How can you clean and prepare slush moulded parts that are soldered on a brass article, for nickel plating?

Answer. Use a mild cleaner containing rosin, rinse and dip in a mild acid dip, rinse and nickel plate.

Elected: H. A. Haisman, 1917 Grove Ave., Berwyn, Ill., Active.

Reinstated: C. McDowell, 801 Maple Row, Elkhart, Ind., Active.

New Application: J. A. Henricks, 2101 Canalport Ave., Chicago, Ill., Associate. J. W. HANLON, *Sec.*

NEW YORK BRANCH

The first meeting in March of the New York Branch was held at the World Building, Park Row, New York City, on Friday, March 8th, 1935. The meeting was called to order at 8:30 o'clock P.M., with the President, Mr. John Rolff, in the chair and thirty-five members present.

After the minutes of the last regular

meeting of February 22nd were read and approved, the President, Mr. Rolff, called upon a committee from the Newark Branch, including Mr. Taylor, the Newark President, Mr. Horace Smith, Past Supreme President, and Mr. Reuter, the Secretary, who were present. Mr. Smith spoke relative to the coming Educational Session and Banquet of the Newark Branch to be held in Newark on April 27th. Newark proposes to banish the depression for this one day at least and promises a good time to all attending.

The New York Branch had for its lecturer of the evening Mr. J. B. Kushner, Ch. E., who spoke on a topic entitled "Precious Metal Losses in Plating Procedure". His talk was well received inasmuch as it presented some interesting facts relative to the operation of precious metal solutions in plating plants. Considerable discussion was had on the topic by the members afterward and Mr. Kushner was extended a vote of thanks for his effort.

The President, Mr. Rolff, then called upon our distinguished member and founder of the Society, Mr. Chas. H. Proctor, who responded with some well chosen remarks relative to the activities of the Society, and last but not least the Branch had the pleasure of being addressed by Mr. William Schneider of the R. & H. Chem. Division of the Dupont Co., one of New York's most popular members and Bill responded with a real treat in impromptu talks in giving his impressions of the progress in plating procedure as seen by him in many plants in the course of his travels for his company. He spoke particularly of the progress in nickel and chrome plating of dye casting material and the new degreasing methods of cleaning prior to electro plating. After a full half hour of interesting talk by Mr. Schneider the meeting was adjourned at 11 o'clock P.M.

F. J. MACSTOKER, *Sec'y-Treas.*

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Report of meeting of New York Branch, held on Friday, April 12th, 1935, at World Building, Park Row, New York City.

President, John Rolff, in chair with all officers and twenty-six of the members present.

Communication from the Hon. H. A. Gilbertson, president of A.E.S., relative to referendum vote on assistant foreman and sustaining membership proposals being held this month, received and read before meeting. New York Branch had taken definite action in opposition to these proposals at a prior meeting of March 22nd.

A communication from the Newark Branch, relative to their coming Educational Session and Banquet, to be

held on April 27th at the New Douglas Hotel, received and read. The New York Branch looks forward with interest and pleasure to this affair and anticipates a goodly number from their membership will go over to New Jersey and renew old acquaintances and enjoy a good dinner and benefit by a splendid educational session.

The trustees of New York Branch made a report of the financial and membership status to the meeting. The members were pleased to hear the favorable news.

A new member, Mr. Aaron Englander, Plating Supervisor of the Presto-Lock Corp., of Brooklyn, N. Y., residing at 729 Lafayette Ave., Brooklyn, N. Y., was elected to membership at this meeting. He is in the active class.

A long and interesting discussion was held after the business meeting on the regulation and specification of deposits by voltage and amperage control, and instruments used for same. It was 11:10 P.M. when the meeting adjourned.

F. J. MACSTOKER, *Sec'y*

News Item

The Lea Manufacturing Company, Waterbury, Connecticut, specialists in the manufacture of buffing and polishing compounds, announces the addition of two well-known research men to its technical staff—Mr. George C. Muscio, chemical engineer, and Dr. Henry L. Kellner.

These two men will devote most of their time to research work in connection with polishing, buffing and electroplating problems and to the development of new products. The Lea Manufacturing Company has greatly enlarged its laboratory for this purpose and will be glad to cooperate with the trade on any of its problems.

HARTFORD BRANCH

The Hartford Branch of the A.E.S. held its monthly meeting on Monday evening, April 22, 1935, at the Hartford State Trade School, Hartford, Conn.

The meeting was called to order at 8:30 P.M., with President St. Pierre in the chair. Minutes of the previous meeting were read and accepted. Communications were read and placed on file.

One communication from the New York Branch and one from the Anderson Branch were read and discussed. The Secretary was instructed to contact each Branch relative to the resolution that it is sponsoring.

After the regular business had been transacted, Mr. Anderson, Engineer for the Norton Mfg. Co., Worcester, Mass., gave a very interesting as well as instructive lecture on "Recent Developments in Abrasives for Polishing."

Mr. Anderson's talk covered the history, source of supply, as well as the development of abrasives and their uses. He also presented each member a sample in a leather case. In conclusion he was given a rising vote of thanks.

The meeting was attended by twenty members and was adjourned at 10:45 P.M.

V. E. GRANT, *Sec.*

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Our President

As we come to the close of another year in the history of our organization we are apt to forget the men whom we elect at the business sessions of the convention to carry on the work of the Society.

The duties of the President are many and varied; he it is who assumes the responsibility and gives the decisions. He knows the ups and downs of each Branch, handling the correspondence and visiting in person in many instances, if necessary. The officers elected to assist him and the committees appointed by him all come under his jurisdiction and it is his duty to see that everyone functions in his particular station that the work of the organization may be carried on successfully.

The President more than any other officer or member has to sell the Society he represents to the public and we have been fortunate in this respect in the choice of the men who have held this high office as the chief executive of the A.E.S. President Gilbertson has had a successful year without being spectacular. His quiet unassuming influence has been felt in every Branch. Perhaps none of our Presidents of late years has been in the news items as little as Mr. Gilbertson, yet there has been no criticism of his administration. The good judgment shown during his years as Secretary-Treasurer has followed him in the higher office to which he was elected last year, with the result that we come to this year's Convention in good financial condition, with an increasing membership reported in many of our Branches and with a more optimistic spirit which even an industrial depression which is still with us can not overcome.

As the presiding officer of this year's annual meeting, Mr. Gilbertson can feel proud of the achievements of his administration and can be assured that our whole membership appreciates the time and thought freely given by him as President of the A.E.S. The direct result of the past year's accomplishments will reach its climax at Bridgeport in June when the Society will hold its annual Convention, which promises to be the biggest and best of its kind ever held by any similar organization. For further proof of this read the papers to be read and discussed at the educational sessions as published in this issue of the REVIEW, ponder over them carefully and persuade yourself that you can't afford to be absent from this year's convention. Every Branch should be represented and every delegate present at all the sessions from start to finish. Remember the place — Bridgeport, Connecticut; and the dates — June 10-11-12-13, 1935. The preparations are all made, the stage is set. Let the Bridgeport Committee show you "*How it is done.*"

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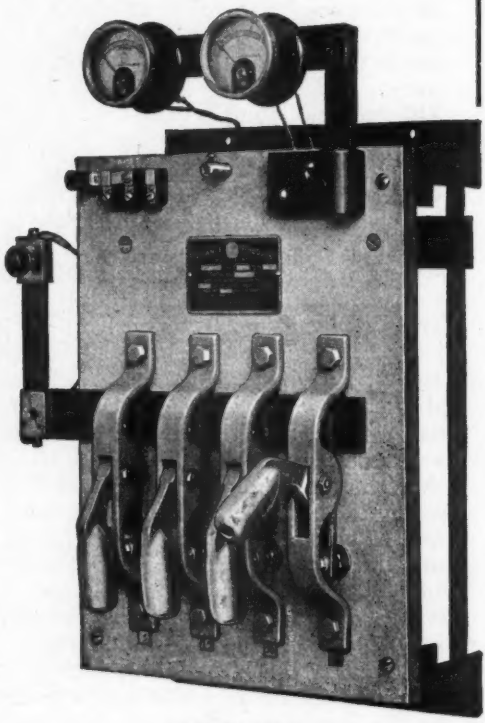

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DEALERS IN PRINCIPAL CITIES

Please mention THE MONTHLY REVIEW *when writing*

SPEEDY AIR-RAIL SERVICE TO BRIDGEPORT, CONVENTION CITY

The secretary has been asked to announce that there is splendid air-rail service from all parts of the United States to the convention city, Bridgeport, available for those who desire to attend but whose time is limited. Illustrative of travel time from various points to Bridgeport are the following examples, showing air transportation time to Newark, New Jersey, from which point there is 3-1/4 hr. train service to Bridgeport:

To Newark, N. J.:

From:		*From*:	
Cleveland	2-1/4 hrs.	Amarillo	10-1/2 hrs.
Chicago	4-1/3 "	Denver	11-2/3 "
Detroit	3-1/6 "	Atlanta	6 "
Omaha	8-1/4 "	Salt Lake City	13 "
Kansas City	7-1/3 "	Los Angeles	18 "
Cincinnati	5-2/3 "	San Francisco	17-2/3 "
St. Louis	6-3/4 "	Portland	18-1/2 "
Minneapolis	7-1/4 "	Seattle	20 "
Washington	1-1/2 "		

One-way airplane fares are equivalent to approximately rail plus Pullman, with a ten per cent reduction on round trips.

Detailed information on air or air-rail trips from any point to Bridgeport will be furnished by any United Air Lines ticket office or Western Union, Postal Telegraph or travel bureau.

SECRETARIES PLEASE NOTE

There are a number of members of the A. E. S. who are not receiving The MONTHLY REVIEW owing to a change of address and the neglect in notifying the Editor as to their new address.

Quite a few copies are returned each month marked "Unclaimed" or "Not at". The names on these copies are immediately taken out of our mailing list.

When you send a new address, please give the old address also. This is important.

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Membership Report

To April 18, 1935

This will be the 11th report of the membership turnover for the current year:

APPLICATIONS

Thos. P. McHugh, 1968 Berkley Ave., Cincinnati, Ohio, Associate
Cincinnati Branch

Max Ackerman, c/o National Tinsel Mfg. Co., Manitowoc, Wisc., Active, Milwaukee Branch

Harvey A. Haisman, 1917 Grove Ave., Berwyn, Ill. Active
Chicago Branch

James W. Overton, 921 East Paterson St., Flint, Mich., Active
Detroit Branch

Harry C. Crook, 1123 Saginaw St., S, Flint, Mich., Active
Detroit Branch

R. C. John, 2121 Hibbard Ave., Detroit, Mich., Active
Detroit Branch

Robert J. Green, Gold Patent Co., Ypsilanti, Mich., Active
Detroit Branch

Frank Lester, 2125 Warger Ave., Dearborn, Mich., Active
Detroit Branch

Wm. H. Ross., 1651 East Grand Blvd., Detroit, Mich. Active
Detroit Branch

Sol Burg, 3794 Humphrey, Detroit, Mich., Active
Detroit Branch

Frank Watt, 3rd and Larned St., Detroit, Mich., Active
Detroit Branch

Aaron Englander, 729 Lafayette Ave., Brooklyn, N. Y., Active
New York Branch

ELECTED

Dr. Richard Ostrander Hull, c/o Grasselli Chemical Co., Cleveland, Ohio, Associate, Cleveland Branch

Raymond J. Simsick, 7028 Holmes Ave., Detroit, Mich., Active
Detroit Branch

Roy Rapp, R.F.D. No. 1, Wyandotte, Mich., Active
Detroit Branch

George A. Lodge, 2100 Hubbard St., Detroit, Mich., Active
Detroit Branch

Russell Raab, 3204 Nolen Ave., Detroit, Mich., Active
Detroit Branch

Franck Gach, 6628 Willette, Detroit, Mich., Active
Detroit Branch

RE-INSTATED

C. McDowell, 801 Maple Row, Elkhart, Ind., Active
Chicago Branch

Hyman Weimar, 648 Mt. Vernon Ave., Detroit, Mich., Active
Detroit Branch

DIED

Mr. G. A. Sederlund, 84 Greene St., Springfield, Mass., Active
Hartford Branch

SUSPENDED

Mike Mrotek, 1108 South 11th St., Manitowoc, Wisc.
Milwaukee Branch

Ed. Wolf, 2410 North 21st St., Milwaukee, Wisc.
Milwaukee Branch

Wm. Kielberg, 191 North Main St., Fond du Lac, Wisc.
Milwaukee Branch

George Simmons, Binghampton, N. Y. New York Branch

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. . . upset a 20 year old "institution"!

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